STATE OF ILLINOIS

LOUIS L. EMMERSON, *Governor*

Department of Purchases and Construction

HENRY H. KOHN, *Director*

FLOOD CONTROL REPORT

An Engineering Study

of the

FLOOD SITUATION IN THE STATE OF ILLINOIS

Prepared under Direction of

THE DIVISION OF WATERWAYS

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CHICAGO
220 S. State Street
June, 1929

[Printed by authority of the State of Illinois.]

Journal Printing Company,
Springfield, Illinois.
1930

20096—2M

LETTER OF TRANSMITTAL.

June, 1929.

To His Excellency, the Governor, the Director of Purchases and Construction and the Members of the General Assembly of the State of Illinois.

FLOOD CONTROL REPORT.

GENTLEMEN: The State of Illinois is bounded and bisected by mighty rivers, all of which are subject to periodical overflow, and are tributaries of the Mississippi.

Flood damages in our State during the past six years have amounted to more than $30,000,000. The city of Beardstown was inundated and Cairo was saved only by the heroism of her citizens and the fact that a crevasse in the levee below the city lowered the Cairo water level at flood crest.

The flood of 1926 was in the Fall of the year and destroyed much of the standing crop in the districts submerged. The 1927 flood came in the Spring and prevented any crop that year. The effect was substantially that of one continuous flood covering a period of seven or eight months and created a situation which prompted the Fifty-fifth General Assembly to pass an Emergency Flood Relief Act, approved July 7, 1927, with an appropriation of $1,500,000 to furnish emergency relief in submerged areas and for the repair and reinforcement of levees which had been, or were in danger of being, destroyed by flood waters.

Another appropriation of $350,000 was made for the protection of the city of Beardstown against flood waters of the Illinois River.

At my suggestion the Fifty-fifth General Assembly also included in the Departmental Appropriation Bill the sum of $50,000 "for an engineering study of the flood situation throughout this State, and for use in conjunction with other states and the Federal government in the development of comprehensive plans for flood prevention and the permanent relief and protection of the people of Illinois from the menace of future devastation by flood waters."

The report submitted herewith has been prepared under the supervision of the writer and Mr. Lorenzo D. Cornish, Chief Engineer of the Division of Waterways.

It is divided into two parts, Part I, relating to Flood Control of the Illinois River, which lies wholly within this State, and Part II, dealing with the Ohio and Mississippi Rivers as flood conditions therein affect the State of Illinois.

Respectfully submitted,

WM. F. MULVIHILL,
Supervisor Illinois Waterway Construction.

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FLOOD CONTROL REPORT.

An Engineering Study of the Flood Situation in the State of Illinois.

INTRODUCTION

By Lorenzo D. Cornish,
Chief Engineer Division of Waterways.

The Fifty-fifth General Assembly of the State of Illinois at its regular biennial session, as a part of House Bill No. 753, which is entitled:

> "An Act to provide for the ordinary and contingent expenses of certain departments of the State government, until the expiration of the first quarter after the adjournment of the next regular session of the General Assembly,"

appropriated the sum of $50,000.00

> "for an engineering study of the flood situation throughout this State, and for use in conjunction with other states and the Federal government, in the development of comprehensive plans for flood prevention and the permanent relief and protection of the people of Illinois from the menace of future devastation by flood waters."

With this purpose in mind, as clearly expressed in the Act quoted above, the Division of Waterways has prepared this report, selecting for special study two of the flood control problems that it regards as of greatest importance to the welfare of the State,—that of the Flood Control of the Illinois River and that of the Mississippi River as affecting the city of Cairo and vicinity.

DISASTROUS FLOODS.

Disastrous floods have occurred during recent years, not only in the Illinois River but in other rivers of this State. The Illinois River, on account of its relatively greater importance, has received more notice than many smaller streams which have also been flooded.

Memorable floods have occurred in the Illinois River in 1844, 1904, 1913, 1922, 1926 and 1927. These floods have reached successively higher stages, not because the run-off or discharge of the river has increased since the first recorded flood of 1844, but because landowners since 1900, under provisions of State laws, have been allowed to build levees and to encroach upon the natural flood plane of the river. Drainage and levee districts have been organized under the laws of the State to reclaim bottom lands. Each district that has built a levee has shut off a portion of the natural flood flow channel, thus adding to the flood heights and increasing the flood hazard of all the other districts.

The flood of 1922 broke the levees of over half of the levee districts along the river, overflowed large areas of rich agricultural land and the cities of Beardstown, Meredosia, Valley City, Naples and Browning, causing great damage to property and business. In 1926, and again in 1927, the disaster of 1922 was repeated, with still higher flood stages. The breaking of the levees during these floods, by providing additional flow area and storage space, decreased or checked the flood which would have reached a higher stage had the levee held and confined the waters.

After the flood of 1922, Mr. M. G. Barnes, then Chief Engineer of the Division of Waterways, made a detailed study and special report on the effect of the levees on the flood stages of the Illinois River, stating very clearly that the levees must be of much greater height, or greater width of floodway provided by setting back portions of the levees, or flood-crest storage provided in some of the districts in order to avoid greater flood disasters.

Along the Mississippi River, on the western boundary of the State, we have some 600,000 acres of bottom lands of which 85 per cent have been reclaimed by Drainage and Levee Districts. Floods have occurred in the Mississippi River in various years which have broken levees, flooded agricultural land and endangered the lives of city populations. During the spring of 1927 the cities of Cairo, Mounds and Mound City, in the southern part of Illinois, having a combined population of 20,000, experienced a severe Mississippi flood that for a time threatened to break all levees and drive the inhabitants from their homes.

In addition to the the Illinois River there are within the State some 24 other rivers of varying degrees of importance which are subject to floods. Nearly all of these rivers have rich bottom lands, capable of growing large crops of wheat and corn and other products when fully protected from overflow. Only a portion of this area may be considered to have adequate protection at the present time. In some of these flooded areas are located cities where lack of proper sanitary conditions, during flood periods, endangers the health of the inhabitants.

STUDIES AND REPORTS.

From time to time the Division of Waterways, as well as its predecessor, the Rivers and Lakes Commission, has made studies and reports covering the flood control of various rivers in Illinois. The State Geological Survey of Illinois has also made several reports. These reports have included the Illinois River, Bay Creek and Cache River, the Saline, the Pecatonica, the Spoon, the Kaskaskia, the Embarrass, the Little Wabash and the Skillet Fork Rivers.

A report on the Illinois River and its bottom lands, prepared by Alvord & Burdick, Consulting Engineers, under the direction of the former Rivers and Lakes Commission, was published in 1915. This report contains an analysis of the previous floods and estimates of the probable flood heights, with the levees which were then constructed and under construction completed. Also an estimate as to the probable flood height if all the land available for agricultural purposes in the lower Illinois valley should be levied and protected from overflow. The conclusions and recommendations in this report were accepted by the

Division of Waterways until the floods of 1926 and 1927 had disclosed the necessity of a new investigation to determine flood heights as affected by the more recent construction of levees.

In the Third Annual Report of the Division of Waterways (1920) are published reports, covering flood control of Bay Creek, the Cache River and the Saline River, by W. G. Potter, Drainage Engineer of the Division of Waterways. The flood control of the Pecatonica River is covered by two reports, one by the Rivers and Lakes Commission in Bulletin No. 18 published in 1916, and one by W. G. Potter, Drainage Engineer, in the seventh annual report of the Division of Waterways (1924). In 1912 the Rivers and Lakes Commission published a report by Jacob A. Harman, Consulting Engineer, on the Reclamation of Lands Subject to Overflow in the Kaskaskia Valley. In 1911 the Rivers and Lakes Commission published a report made by C. G. Elliott, Chief of Drainage Investigation, U. S. Department of Agriculture, on The Prevention of Overflow of the Little Wabash and Skillet Fork Rivers. The Reclamation of Lands Subject to Overflow in the Embarrass River Valley, is covered by a report of Jacob A. Harman, Consulting Engineer, published in 1913 by the State Geological Survey of Illinois. The State Geological Survey published another report by Jacob A. Harman in 1916 on the Reclamation of Lands Subject to Overflow in the Spoon River Valley.

Based on the value of protection to navigation the United States Army Engineers have made surveys of various rivers in Illinois and some of these surveys are in progress at the present time.

The purpose of the reports published by various State agencies has been to provide studies and preliminary plans, which could be utilized by the local interests affected for the saving of human life and preventing the loss of crops and live stock, the damaging of roads, bridges and other structures, amounting to millions of dollars annually.

On some of the rivers of the State flood control projects have been constructed in the upper portion of the valleys, only, thereby increasing the maximum flood discharge lower down. Studies should be made of these streams and surveys made from the mouth upward and a comprehensive flood control plan developed for each.

STATE APPROPRIATIONS FOR FLOOD RELIEF.

From time to time the General Assembly of the State of Illinois has recognized the public benefit which will result from flood control and protection by appropriating State funds for this purpose. Between 1913 and 1915, $384,000 was appropriated for building flood protection works to protect the cities of Cairo, Mound City and Shawneetown on the Ohio River. In 1913, $3,000 was appropriated to rebuild the levee protecting the village of Naples and in 1925, $10,000 was appropriated to raise and strengthen this levee. The Fifty-third General Assembly of the State of Illinois, in 1923, made an appropriation for construction of levees around the city of Beardstown. The Division of Waterways prepared plans for this work, which are shown in its report for the fiscal year ended June 30, 1924. The cooperation of the city of Beardstown in this protection work was not obtained, however, until after the floods of 1926 and 1927. The Legislature of 1927 reappropriated $350,000 and,

with funds contributed by the railroads, the protection works have now been built.

The recurrence, in 1926 and 1927, of floods having greater height and greater destruction, so soon after the flood of 1922, caused the Legislature of 1927 to make an appropriation of $1,500,000.

> "for the purpose of furnishing all necessary and proper emergency relief in areas which have been inundated and damaged by flood waters and for making temporary repairs to, or furnishing temporary reinforcements for levees which are in danger of being damaged by the flood waters of the last several months, and to reclaim or restore inundated and overflowed lands."

Under this appropriation contracts were let and the levees in the Illinois River valley and along the Mississippi in the southern part of this State were restored. Some of this work is still in progress.

COMPREHENSIVE FLOOD CONTROL PLANS NEEDED.

From the engineering standpoint, as well as from the standpoint of economy, in order wisely to spend appropriations made for flood control, comprehensive plans should be provided and a definite construction policy adopted. Heretofore studies have been made of flood control problems affecting various rivers of the State in response to local demand or as appropriations became available. Appropriations which have been made heretofore, although not a part of a general flood control scheme, as a rule, have been wisely spent and have not been wasted. But there has been no general scheme, based upon sound engineering data, providing that appropriations should go where the need was greatest and that flood control work might bear its proper relation to other construction.

Interrelated with the problem of flood control we have that of protecting navigation, and also the problems of sanitation as affecting cities and of transportation over bridges and concrete highways. The interrelation of these various problems, which affect the welfare of the whole state, requires the adoption of a State-wide, comprehensive plans for their solution.

COOPERATION OF STATE AND FEDERAL AGENCIES.

Section six of the Mississippi River Flood Control Act, passed by Congress of the United States and approved May 15, 1928, provides that flood control works may be constructed by the Mississippi River Commission on the tributaries as far as the Mississippi River backwater influences their stages, provided, however, that the State or local communities must pay one-third of the cost and also furnish the right-of-way without expense.

The Mississippi River Commission has assumed jurisdiction over the Illinois River for flood control work from the mouth to the upstream city limits of Beardstown. The back-water of the Mississippi during extreme floods influences the stage of the Illinois River, however, as far as Peoria and there is a possibility that the Mississippi River Commission may extend its jurisdiction to the latter city. The people of Illinois are, therefore, deeply interested in the provisions of this Act, as applied to the flood control of the Illinois River and other tributaries of the Mis-

sissippi, and the State should, it seems to me, prepare complete and comprehensive plans in order that it may be in position to take advantage of any scheme of cooperation which may develop.

For full text of the Mississippi River Flood Control Act see Section IV, of Part II hereof.

ILLINOIS RIVER FLOOD CONTROL.

Illinois River Flood Control has been selected for detailed investigation and report, because this river, the largest of the State, draining some 28,000 square miles of watershed and having along its lower 226 miles over 400,000 acres of bottom land subject to overflow by floods, presents a problem the solution of which more vitally affects the welfare of the State than does that of any other river lying within its borders.

The Illinois River extends southwesterly across the northern and central portion of the State, a distance of 275 miles. In this distance eight railroads cross the river by means of bridges and approaches that are subject to damage during flood periods. There are also nine highway bridges, constructed or proposed, which form important links in the hard roads system of the State. Approaches to these highway bridges are in every case except one through bottom lands protected from overflow by levees. There are also important secondary roads leading to ferries located behind levees. When levees break, communication is interrupted and the resulting damage to business and to private individuals can hardly be estimated.

The State of Illinois is building, at a cost of $20,000,000, a waterway connecting the Chicago Sanitary and Ship Canal at Lockport with the Illinois River at Utica. When "The Illinois Waterway" is completed, and the Federal government has finished dredging the Illinois River between Utica and Grafton, a navigable channel at least nine feet in depth will be available for barge traffic between the Great Lakes and the Mississippi River. During the last eight years, under Federal government supervision, there has been a great increase in barge line traffic on the Mississippi River. During 1928, 546,491 tons of merchandise, grain and ore passed through the barge line terminal at Cairo alone. Similarly the completion of the Illinois Waterway will result in a rapid development of barge line traffic on the Illinois River. The protection of this traffic and the preservation of all navigation during flood periods will be facilitated by the construction of proper flood control works.

The problem of flood control along the Illinois River is one requiring considerable study. For this purpose and to get out plans and recommendations with estimates of costs, the Division of Waterways employed Mr. Jacob A. Harman, Consulting Engineer, of Peoria, Illinois, who has had many years of practical experience in levee building and flood control work and a long acquaintance with the Illinois River. Mr. Murray Blanchard, Hydraulic Engineer for the Division of Waterways, was assigned to assist him in the study of this problem.

The report of the Consulting Engineer herewith is approved as a general plan for flood control of the Illinois River and the recommendations concurred in.

FLOOD PROTECTION FOR CAIRO AND VICINITY.

Aside from New Orleans, Cairo is the largest city of the Mississippi Valley subject to floods. The protection of Cairo and vicinity from floods of the Mississippi and Ohio Rivers is of great importance, the safety of a large population is involved and the safe-guarding of human life must be the first concern of the State.

Under the provisions of the Mississippi River Flood Control Act, before referred to, the Federal government has adopted a plan for controlling Mississippi River floods. The advisability of making a study and preparing plans and estimates of cost, so as to be in a position to cooperate with the Federal government was an additional reason for including the study of the flood protection of Cairo in this report. Mr. L. T. Berthe of the Berthe Engineering Company of Charleston, Missouri, was employed to make a study of Mississippi River Flood Control as affecting the city of Cairo. His long experience in dealing with Mississippi River flood problems makes his report worthy of careful consideration. The essential parts thereof with introduction and conclusions by the Division of Waterways are printed as Part II of this report on flood control in Illinois.

PART I—FLOOD CONTROL—ILLINOIS RIVER.

Prepared Under the Direction of the Division of Waterways of the Department of Purchases and Construction State of Illinois.

Mr. L. D. Cornish, Chief Engineer, Division of Waterways, Chicago, Illinois.

DEAR SIR: Herewith please find report on the "Flood Control of the Illinois River," consisting of—

1. The general report of the studies, conclusions and recommendations, together with maps, tables and diagrams.
2. Appendix "A"—Tables, diagrams and discussion of rainfall on the Illinois River watershed and the relation of rainfall to the Illinois River stages.
3. Appendix "B"—Tables and diagrams of hydraulic data and computations.

In writing this report I have used records of daily river stages of the Illinois River and its tributaries for the year 1905 to 1927, inclusive, as kept by the U. S. Weather Bureau, the Engineers of the U. S. War Department, Sanitary District of Chicago, and others, as compiled and furnished by the engineers of the Sanitary District of Chicago.

The search thru the surveys, reports, rainfall and river stage and discharge records has been long and tedious and much labor required for their compilation, reconciliation and adaptation to a study of the flood relations, which were most baffling due especially to the numerous, sudden and violent changes in both the stages and the discharge rates of the Illinois River resulting from the breaking of levees and flooding of many levee districts as each major flood has approached its crest.

It has been the purpose to present in this report, for future reference, all available records and computed data that have been considered as having a bearing upon the conclusions and recommendations herein.

In this work, which has required patient and persistent study, I have been ably assisted by Mr. G. W. Pickels, Professor of Drainage Engineering, University of Illinois, on the rainfall data; by Mr. Murray Blanchard, Hydraulic Engineer of the Division of Waterways, on the discharges, and by members of my organization in developing methods in the solution of the problems presented. To all of them and to other engineers of the Division of Waterways, to the members of the U. S. Engineer Corps, the U. S. Geological Survey, the Illinois State Geological Survey and to engineers of the Sanitary District of Chicago, who have supplied much valuable data and offered many useful suggestions, I wish to express my thankful appreciation.

Respectfully submitted,

JACOB A. HARMAN, *Consulting Engineer.*

Peoria, Illinois, April, 1929.

FINDINGS AND RECOMMENDATIONS.

The following brief summary gives the principal Findings and Recommendations resulting from the study of the Illinois River Flood Problem as disclosed in this report.

FINDINGS.

1. The overflowed area in the Illinois River Valley from Grafton to LaSalle represents a total of about 400,000 acres, of which 200,000 acres are now leveed and about 70,000 acres more might be leveed for agricultural or storage purposes. The remainder of the area is water surface in the river and lakes and the narrow areas of land between the river and the levees, or the foot-hills, and is necessary for flood carrying purposes.

2. From Grafton to Otter Creek, about 13 miles, there are no levees. From Otter Creek to Beardstown about 130,000 acres, or 95 per cent of all the available land has been leveed; from Beardstown to Havana 19,000 acres, or 30 per cent of all the available land has been leveed; from Havana to Peoria 37,000 acres, or 73 per cent of all the available land has been leveed; from Peoria to LaSalle only 2,600 acres, or 4 per cent of all the available land has been leveed.

3. Flood heights have been increased thruout the entire lower valley of the Illinois River by construction of levees.

4. The water diverted from Lake Michigan thru the Chicago Sanitary and Ship Canal increases all stages of the Illinois River the same as an equal added volume from a tributary stream.

5. The flood heights would be much greater from LaSalle to Beardstown if the remaining available open areas should be leveed.

6. The rainfall producing the flood of October 1926 was the greatest of record on the Illinois River Watershed.

7. About one-half of the levee districts have been flooded by breaking of levees as each major flood has approached crest since the levees were built.

8. A number of districts have been flooded by hill streams overflowing the levees before reaching the river.

9. Back-water computations for the discharge of the flood of October 1926, will all levees holding, show that the flood stages along the Illinois River would have been higher if entering the Mississippi River at the 1844 stages, as follows:

At Peoria	0.46 feet
At Copperas Creek	0.80 feet
At Havana	0.95 feet
At Beardstown	1.10 feet
At Meredosia	1.62 feet
At Pearl	3.36 feet
At Kampsville	4.37 feet
At Grafton	8.40 feet

10. High water stages in the Mississippi River produce a backwater effect and increase normal flood crest stages on the Illinois River from Grafton to LaSalle.

11. The flood discharges of the Illinois River at Peoria and Beardstown and the present carrying capacity of the river, with all levees holding, are from 10 per cent to 20 per cent smaller than those used in all previous studies for future flood heights.

12. Additional discharge measurements of the Illinois River at flood stages, with all levees holding, are needed to clear up differences in previous measurements not satisfactorily accounted for.

13. The maximum discharge of the Illinois River that may be expected to occur within a period of 100 years, will not exceed the following:

At LaSalle	75,000 cfs.
At Peoria	79,000 cfs.
At Havana	86,000 cfs.
At Beardstown	130,000 cfs.
At Pearl	135,000 cfs.
At Kampsville	137,000 cfs.
At Grafton	140,000 cfs.

14. The carrying capacity of the Illinois River, as determined by our investigations, indicate that the maximum rate of discharge of the 1904 flood at Peoria was not more than 75,000 cfs.

15. Flood crest storage in leveed areas has little effect upon the further rise of the river after such areas have been filled.

16. The construction of additional levees that would materially reduce the floodway area and the valley storage will further increase the flood stages.

17. The most practicable method now available for adequate flood control is the improvement of the Illinois River levee system by enlargement and by setting some of the levees back and widening the floodway.

18. The flood stages of the Illinois River in October 1926, with all levees holding, would have been higher, as follows:

At Peoria	1.33 feet
At Copperas Creek	1.92 feet
At Liverpool	1.93 feet
At Havana	1.77 feet
At Beardstown	1.79 feet
At Meredosia	2.56 feet
At Valley City	2.20 feet
At Pearl	2.89 feet
At Kampsville	1.97 feet

19. Setting levees back as proposed in this report will reduce the maximum flood stages as follows:

At Peoria	1.72 feet
At Copperas Creek	3.00 feet
At Liverpool	2.86 feet
At Havana	2.14 feet
At Beardstown	2.67 feet
At Meredosia	1.98 feet
At Valley City	1.33 feet
At Pearl	0.00 feet

20. The average height of the enlarged levees for a miximum flood is 19.2 feet, and the average height for the enlarged levees, with set-backs as proposed, is 17.7 feet, or an average reduction of all levee heights of 1.5 feet, and reductions at Copperas Creek of 3.0 feet and Beardstown of 2.86 feet.

21. The estimated cost of the enlargement of existing levees to grade, three feet above maximum computed flood stage, is $11,500,000 and the estimated cost of enlargement and set-back levees for the same flood discharge is $11,000,000. The total cost of levees to date has been about $12,000,000, exclusive of interest, maintenance and repairs.

22. The levees at Beardstown and the "seawall" recently built by the Illinois Division of Waterways will protect the city against a flood stage 3.6 feet higher than that of 1926 by using flash boards on the "seawall" as comtemplated. The flood stage at Beardstown with a discharge 20,000 cfs. greater than that of 1926, entering the Mississippi River at 1844 flood stage, and all levees holding, will be 5.2 feet above that of 1926, or with the levees set back, as proposed, 2.5 feet above that of 1926.

23. The levee height of three feet above the flood profile provides an emergency factor of safety of about 10,000 cfs. in added carrying capacity for each foot of levee above flood stage.

24. Until all levees are enlarged to approximately the grade lines as indicated, the weaker or neglected levees will break with each recuring major flood, and arrest the rise of the river to the extent of the timely storage thus produced.

RECOMMENDATIONS.

1. That the system of levees along the Illinois River be placed under more direct control of the Illinois Division of Waterways, or other designated agency of the State, for administration of the improvements and maintenance of the levees in cooperation with the Levee District Officers and the U. S. Engineer Corps and Mississippi Flood Control Commission.

2. That a program for Flood Control should include setting levees back and using at least one of the present levee districts to reduce flood stages.

3. That permits for levees and other structures that may occupy any portion of the floodway be granted only as the public interest may best be served and the benefits will offset the damages, considering the increase in flood stages that may result.

4. That detail study and consideration be given to the economic value of using some of the levee districts and of enclosing some of the remaining overflowed areas for crest storage to reduce floods in connection with the use of such areas as permanent game and fish preserves.

5. That especial attention be given to obtaining adequate discharge measurements and gauge readings on the Illinois River and its tributaries to verify or correct the data and conclusions found in this report.

SECTION I—GENERAL DISCUSSION.

INTRODUCTORY.

The present investigations and report on flood protection in the lower Illinois Valley is concerned with an investigation of works constructed that affect flood heights and a critical review of all previous reports and available data relating to floods. The particular problems considered may be stated as follows:

1. Determination of the magnitudes of the great floods.
2. Carrying capacity of Illinois River as leveed.
3. The effect on flood heights of levees built and possible additional levees.
4. Methods of handling floods.
   (1) Raising levees.
   (2) Setting levees back.
   (3) Flood crest storage.
   (4) Tributary stream storage.
5. Comparative costs.
6. Values created or preserved.

FLOODS OF THE ILLINOIS RIVER.

There are five (5) especially memorable flood years, viz., 1904 before the levee building era; 1913 when about half of the levee districts were completed, most of them being located below Valley City; 1922 when about 90 per cent of the present leveed area had been enclosed, and nearly one-half of that area was flooded by breaks in levees; 1926, with about 180,000 acres enclosed by levees more than one-half of this leveed area flooded; 1927, with all but three or four of the levees which broke in 1926 remaining open. The great flood of 1844, surpassing all flood heights thruout the entire lower valley before the levees were constructed, was exceeded in height at Beardstown and vicinity in 1922, 1926 and 1927.

The flood of 1913 showed a very marked effect of levee building upon the flood stages in the Illinois Valley in the vicinity of Beardstown, as compared with the flood stages above Beardstown. The Rivers and Lakes Commission of Illinois published a report on the Illinois River in 1915, which was prepared by Alvord & Burdick, Consulting Engineers, giving a comprehensive study of the Illinois River flood problem. The Alvord and Burdick report predicted future flood heights, as follows:

1. With a discharge equal to that of 1904 entering the Mississippi River at a flood stage of that year, and with the levees of all districts then organized, completed and holding, the stage at Beardstown would be about 3.7 feet above the observed stage, or a reading on the Beardstown gage of 23.7 feet.

2. With a discharge the same as that for 1904, but entering the Mississippi River at a flood stage equal to that of 1844 and the levees of all districts then organized, completed and holding, the flood stage at Beardstown would be about 4.0 feet high than that observed, or a stage of 24.0 feet on the Beardstown gage.

3. With a discharge about 35 per cent greater than that of 1904 entering the Mississippi River at the flood stage of 1904, and levees of all districts then organized, completed and holding, the stage at Beardstown would be about 4.4 feet higher than that observed for the flood of 1904, or 24.4 feet on the Beardstown gage.

4. With a discharge about 35 per cent greater than that of 1904 entering the Mississippi River at the flood stage of 1844, and levees of all districts then organized, completed and holding, the stage at Beardstown would be about 6.0 feet above the observed stage of 1904, or about 25.0 feet on the Beardstown gage.

The flood of 1922 overflowed 21 or 22 levee districts, inundating about 65,000 acres of leveed land and invading the city of Beardstown, approached the maximum stage predicted in the Rivers and Lakes Commission Report, but did not produce as great a discharge as in 1904. The Chief Engineer of Division of Waterways made a special report on the flood of 1922, and the engineers of the United States War Department made a special report on the same flood in 1923. The floods of 1926 and 1927 exceeded the flood stages of 1922 and caused much greater damage to levees and land in levee districts and to Beardstown and other cities along the lower Illinois River.

Considering somewhat in detail the comparative flood stages at Beardstown, where the greatest increase in stage occurs, we find that the flood of 1926 reached a stage of 26.36 feet on the Beardstown gage, which is 5.35 feet above the flood stage of 1904, and 1.65 feet above the flood stage previously estimated by Alvord and Burdick in their report above noted. The effect of levees is thus very definitely disclosed by the observed river stages, but a satisfactory comparison of the flood magnitudes requires a detail study of the effects of levees on the carrying and storage capacities of the Illinois River Valley.

Before entering into a detailed consideration of the surveys and other data available, it would seem desirable to review, briefly, the history of the Illinois Valley and its topography, geology and development.

WATERSHED MAPS.

The watershed of the Illinois River occupies nearly one-half the area of the State, averaging about 125 miles wide and extending from the west central portion northeasterly across the State into Wisconsin and Indiana and touching the Michigan State line. About two-thirds of the area lies south of the Illinois River and about one-third lies north of the Illinois River. The Illinois River is formed by the junction of the DesPlaines and Kankakee, and the other largest single tributary is the Sangamon River entering the Illinois above Beardstown. The accompanying map, Figure No. 1, shows the State of Illinois and the boundaries of the Illinois River watershed, extending into Wisconsin and Indiana. The accompanying map, Figure No. 2, is a larger scale drawing showing the Illinois River watershed, the principal tributaries and sub-tributaries and the drainage areas of the tributaries. This map is reproduced from the data furnished by Illinois State Geological Survey Base Map.

HISTORICAL SKETCH OF ILLINOIS RIVER.

The Illinois River Valley has been the subject of many surveys, investigations and reports, but not until after reclamation of a large part of the overflowed area by leveeing for agricultural purposes did the flood conditions become so pronounced and resulting damages so great as to be of general public interest. The Illinois River watershed extends across the middle western and the northeastern portions of Illinois with head waters of the Fox and DesPlaines in Wisconsin and the Kankakee and Iroquois in Indiana. The natural divide between the Illinois River watershed and Lake Michigan in the vicinity of Willow Springs was a low marshy area, which was overflowed by the DesPlaines flowing both to the Illinois River and thru the Chicago River to Lake Michigan. This divide was about eight feet above the low water level of Lake Michigan (1847) and the shortest portage for the water route between the Great Lakes and the Mississippi River.

In 1673 Joliet and Marquette, going by way of the Fox-Wisconsin route from Green Bay, discovered the Mississippi River and floated down same to the mouth of the Arkansas River. On their return they were persuaded by the Illinois Indians to take the Illinois River and were the first white men to cross the Chicago Divide in September, 1673. Under date of August 1, 1674, Marquette first proposed a canal across the Chicago Divide, in a letter to his friend, Father Dablon, as follows:

"A very important advantage, and one which some, perhaps, will find it hard to credit, is that we could easily go to Florida in boats, and by a very good navigation. There would be but one canal to make—by cutting one-half of a league of prairie—to pass from the Lake of Illinois (Lake Michigan) into the St. Louis River (DesPlaines River). The route to be taken is this: The bark should be built on Lake Erie, which is near Lake Ontario. It could easily pass from Lake Erie to Lake Huron, from which it would enter the Lake of Illinois. At the extremity of this lake would be the cut or canal of which I have spoken, to have a passage to the St. Louis, which empties into the Mississippi. The bark having entered this river could easily sail to the Gulf of Mexico."

In 1679 LaSalle built a boat on the shores of the Niagara River, which was the first vessel to sail the upper lakes. He landed at the mouth of the St. Joe River and established Fort Miami. He proceeded up the St. Joe River and crossed over to the Kankakee marshes near South Bend, Indiana; thence down the Kankakee River and Illinois River to the Illinois villages, where he arrived January 1, 1680. He established Fort Creve Coeur, on the east side of Lake Peoria, which has recently been identified as located on the high bluffs over the bend of the river, just below the city of Peoria. He returned to Fort Miami, going by way of the DesPlaines River to Joliet, thence overland to Lake Michigan, near the mouth of the Calumet.

On January 4, 1682, LaSalle proceeded from a rendezvous which he had established at "Chegaugou" on sleighs to Lake Peoria, where he found open water and launched his boats and proceeded southward by the Illinois and Mississippi Rivers, and arrived at the Gulf of Mexico,

April 9, 1682. He returned and established Fort St. Louis at Starved Rock, in December of the same year.

The DesPlaines-Chicago route was generally used by the early French explorers in passing from the Great Lakes to the Mississippi River.

Description of the condition of the Divide is found in the report dated April 4, 1819, of Messrs. R. Graham and Joseph Phillips, as follows:

"The route by Chicago as followed by the French since the discovery of the Illinois, presents at one season of the year an uninterrupted boat communication of six to eight tons burden between the Mississippi and the Michigan Lake; at another season a portage of two miles; at another, a portage of seven miles from the bend of the Plein (DesPlaines) to the arm of the lake. And at another, a portage fifty miles from the mouth of the Plein to the lake, over which there is a well beaten wagon road. Boats and their loads are hauled by oxen and vehicles kept for that purpose by the French settlers of Chicago."

The importance of the Illinois-Mississippi route as a waterway has been advocated since Marquette's discovery and emphasized by reports recommending the construction of a ship canal across the Chicago Divide from Lake Michigan to the Illinois River. In 1808 a report on "Means of Internal Communication," by Albert Gallatin; in 1811 the "Illinois Waterway" was reported to Congress in a bill along with the proposed Erie and other canals.

In 1822 the United States granted a right-of-way to the State of Illinois to build the Illinois-Michigan Canal through the public lands. From LaSalle to the mouth, the Illinois River had no rapids and it was necessary to construct a canal from the Chicago River through the valley to LaSalle. The State of Illinois started proceedings for the construction of the Illinois-Michigan Canal in 1823 and authorized its construction in 1829. The work was begun in 1836 and the canal opened to traffic in 1848. The original plans provided for a lake level canal through the Chicago Divide, but on account of shortage of funds plans were modified and the canal constructed with a summit level eight feet above Lake Michigan (low water of 1847—Chicago Datum) with a feeder through Sag Valley from the Calumet River, supplemented by lift wheels at Bridgeport, when the water supply was deficient.

The city of Chicago took its water supply, as now, from Lake Michigan and disposed of its sewage through the Chicago River into the lake. The wheels at bridgeport, which were installed to maintain the water supply in the canal, were operated at times to cleanse the Chicago River, and in 1866-1871, the city of Chicago cut the summit level of the canal to the original plan, and the water of Lake Michigan flowed by gravity through the canal to the Mississippi River. In 1881 the Legislature of Illinois, by joint resolution, required the city of Chicago to erect and maintain pumping works at the entrance of the canal at Bridgeport to cleanse the Chicago River and protect the city water supply. These pumps were put into operation in 1884 and continued until the Chicago Sanitary and Ship Canal was completed in January, 1900.

As the population and industries of Chicago continued to grow, the amount of water which could be delivered through the canal from the pumps at Bridgeport was not sufficient to cleanse the Chicago River and to protect the city water supply. The sediment partially filled the canal so the carrying capacity became less as the population and demand for more flow increased.

The necessity for a better method for disposal of the Chicago sewage, and one which would not pollute the city water supply, resulted in the passage by the Illinois Legislature of the "Act to create Sanitary Districts and remove obstructions in the DesPlaines and Illinois Rivers," in force July 1, 1889. Under this Act the Sanitary District of Chicago was established by popular vote at the general election on November 5th of that year.

The Sanitary District Act provided that, for the purpose of diluting the sewage from the city of Chicago, so it would not be injurious to the health of the inhabitants of the DesPlaines and Illinois Valleys, there should be drawn from Lake Michigan, through the Chicago River and the canal, or canals, to be constructed, 20,000 cubic feet of water, per minute, for each 100,000 population of the Sanitary District.

The Act authorizing the organization of the Sanitary District of Chicago provided that the owners of land in the Illinois Valley might recover damages from the district for overflow, due to the diversion of water from Lake Michigan into the Illinois River.

The condition of the bottom lands in the lower river valley, prior to 1900, were described in the early reports on the examination of the Illinois River Valley. Captain Howard Stanbury in 1838 described the valley as from one to five miles wide, deeply overflowed in every freshet, filled with bayous, ponds and swamps, and infested with wild beasts; clothed with dense vegetation, which was "a forbidden wilderness ever incapable of inhabitation by man." General Wilson in his report of 1867, referring to Stanbury's statement, says, "it may be true in part, but already cultivation has begun to encroach upon the higher bottom lands." General Marshall in 1890 described the bottom lands and says— "cultivation has extended over the higher bottoms; in fact, it extends everywhere they can get it in seed before the flood begins." "At about the 12-foot stage, the sloughs, the ponds, the lakes and the lower part of the bottoms are filled; at a 16-foot stage 80 per cent of all the lands that are ever flooded are already covered."

DESCRIPTION OF ILLINOIS WATERSHED.

The physical and geological features of the Illinois and its watershed are set out in the Alvord & Burdick Report to the "Illinois River and Lakes Commission" published in 1914, and with slight modifications is herewith presented:

The Illinois River is one of the most unusual streams in the United States. Its past importance as an avenue of water commerce, the possibilities of its future in this respect, its fresh water fisheries, its use as

NOTE: Additional historical information and references to the early history of the Chicago Divide, and the Illinois River as a waterway, may be found in the "Illinois Waterway Report" by the Internal Improvement Commission of Illinois, published in 1909.

the main sewer (so to speak) of the second city of the country, and more recently, the agricultural development on its bottom lands through the construction of levees, all have led to perhaps more through studies, with various objects in view than has been received by any other of our rivers.

The Illinois River is formed by the junction of the DesPlaines and Kankakee Rivers, 273 miles by river above its mouth at Grafton. It flows nearly west 62 miles to the Great Bend near Hennepin, and thence pursues its course nearly south, 211 miles, to its junction with the Mississippi River. Its watershed, estimated at 27,914 square miles, lies principally within the State. The upper waters of the DesPlaines and Fox Rivers drain 1,080 square miles in Wisconsin, and the head-waters of the Kankakee furnish the outlet for 3,207 square miles in Indiana.

The principal tributaries are the Kankakee, 5,146 square miles, the DesPlaines, 1,392 square miles, the Fox 2,700 square miles, and the Vermillion, 1,317 square miles, all joining the upper river above Hennepin. Below the Great Bend the Illinois receives the Mackinaw, 1,217 square miles, Spoon River, 1,817 square miles, the Sangamon, 5,670 square miles and Crooked Creek, 1385 square miles. The remaining watersheds are small, none exceeding 1,000 square miles. About two-thirds of the tributary watershed lies to the southeast. In the lower 60 miles no important drainage reaches the stream from the west, the dividing line between the Illinois and the Mississippi which here flow in parallel courses, lies not more than ten miles westward.

The greater part of the drainage area is a typical Mississippi Valley prairie region. The slopes are flat to the north and east, but become more rolling in the lower half of the watershed.

The upper waters of the Fox River serve a poorly drained lake region, largely in Wisconsin, and more than half of the Kankakee watershed comprises the marsh region of northern Indiana, now nearly completely drained and reclaimed. The dividing ridge of the basin ranges in elevation from 700 to 1,000 feet above the sea, and the river itself from 499 feet at its head to 412 feet at its mouth.

THE RIVER BOTTOMS.

From the head of the river to LaSalle, a distance of 50 miles, the fall of the stream is comparatively rapid, dropping about 53 feet. The stream is flanked on either side by bluffs or sharply rising ground nowhere more than two miles apart, and narrowing to about one-quarter of a mile near Seneca. The bottom lands are comparatively high, and in general rise toward the base of the bluff. High water is of comparatively short duration, and it does not prove advisable to dike the farm land.

Below LaSalle the conditions are quite different. In 223 miles the fall is only 33 feet, and for the first 80 miles only six feet. As in the upper river, the bottoms are flanked by bluffs or hills, but the flood plain is wider, ranging from one and one-half to three miles above Peoria, three to five miles near Havana, and six to seven miles near Beardstown, at the mouth of the Sangamon River. In the lower 60 miles, the bottom lands are generally three to four miles in width. From LaSalle to the Mississippi, the bottom land subject to flood aggregates about 400,000

acres or 620 square miles. The immediate banks of the stream are nearly everywhere higher than the bottoms further inland, gradually falling away to lakes, ponds and marshes near the foot of the bluffs. Some exceptions to this rule are found at the deltas of the larger tributaries.

From LaSalle to Beardstown, the river banks lie generally from seven to twelve feet above low water, averaging about ten feet. Many lakes and sloughs between the river banks and the foothills are connected with the river at low or medium stages of water and lie at approximately the same elevation as the river, rising and falling with it. The low water connection is always at the foot of the lake. At moderate stages of flood they are connected with the river at their upper ends also. The lakes receive and carry a portion of the flood flow in its passage down the valley and, together with the overflow land, act as storage reservoirs, reducing the maximum flood flow rate. Below Beardstown the immediate banks of the stream are higher, the filling of the bottom lands has progressed further, the lakes are smaller, many of them lying 10 feet or more above low water in the main stream. They are thus only invaded by river stages considerably above normal.

The course of the river from the Great Bend to its mouth is unusually direct. The fall is so slight that there is little or no erosion of banks or stream beds and sediment brought down by tributaries is not carried very far. Throughout the greater part of its length, particularly in the lower 60 miles, the stream follows the base of the western hills, with occasional diversions toward the center of the valley where the stream has been pushed outward by the deposit at the mouth of an important tributary.

Throughout its course the low water banks of the stream are thickly overgrown with trees and brush, and in the lower reaches of the river particularly, the bottoms are veritable jungles of trees, shrubs and climbing vines. In its natural state all ground within a few feet of the low water line in river and lakes was thus thickly over-grown. The only open places above Beardstown are lakes, ponds and sloughs and their low lying borders submerged for a large part of the year, during the low water season are covered with swamp grass and rushes. Below Beardstown large areas of prairie occupied the level reaches of overflowed valley between the timbered stretches along the banks of river and lakes.

GEOLOGY.

The geological history of the Illinois River is instructive. It serves to show the reasons governing the peculiarities of the river bottom topography, indicates tendencies still operative, but somewhat modified, and materially assists in final conclusions as to what future floods may be expected, through comparison with other streams upon which longer record periods are available. It seems to indicate why excessive flood rates of some streams are not applicable to the Illinois.

In the ice cap period an estuary of the Gulf of Mexico extended north to the vicinity of Cairo, and glacial lobes converged on the low lying region represented by Illinois and the adjacent margins of border-

ing states. The topography relief was built up as far south as 37½ degrees (Grand Tower to Shawneetown) and the south estuary filled in as the delta or alluvial region of over 30,000 square miles between Cairo and the Gulf. Water passes were carved across the northern highlands and between the lake region and the Mississippi River, from all of which the flow gravitated toward the region of Illinois.

The territory drained by the Illinois is almost entirely within the area of glaciation. From the head-waters to Peoria the glacial debris belongs to the Wisconsin period. From Peoria to the southern line of Pike County, the drift is Illinoisan capped along the valley by loess, a fine grained clay-like formation. From this place southward the drainage area is quite small, especially to the west of the river, which is unglaciated, but the surface is largely covered by loess. To the east there is a moderate amount of drift also capped by loess. The visits of the glaciers have had a very marked effect upon the character of the present streams draining the region of their occupation, and the watershed of the Illinois River is principally characteristic of the glacial epoch. The glacial debris overlying rock, with few exceptions, is from 20 feet to several hundred feet deep, the greater depth predominating.

It is well known that when materials are eroded by flowing water, the heavier particles are dropped first and the lighter materials are carried longer distances. Thus, in the valley of the Mississippi River, the upper portion of its ancient channel is paved with coarse sand and gravel. Further southward in Illinois, Iowa and Missouri, the deposits are finer, coarse gravel being scarce. Sand where found is usually coarse to the northward, and becomes finer to the southward. In the lower river the later deposits are of finely divided clay, and at New Orleans for nearly all the year, the water is charged with clay particles so fine that many weeks of settling are required to deposit them. The water has rid itself of sands and gravel, except in the greatest floods.

Similar facts are observable in the territory occupied by the glaciers. The rocks over which they moved were worn, scraped and broken, resulting in debris varying from the largest boulders to finely divided dust. The melting waters took up these materials transported them under and through the ice, and upon emerging, first deposited the boulders, then the gravel, then the coarse sand, then the fine sand, and lastly the more finely divided clay. Likewise where the glaciers rested for long periods, in their recession the melting waters deposited all kinds of debris which were washed over by the melting of the ice further north, and the materials were sorted in the order above described, the coarser materials in the north and the finer materials in the south.

This sorting of the glacial debris is the principal cause of marked differences in the flow characteristics of the streams in the northern United States. In the north, in Wisconsin and Michigan, and parts of New York and New England, the sands and gravels predominate.

For an explanation of the topography of the present river valley, we are also indebted to the research of the Geologists. The sharp distinctions between the physical features above and below the Great Bend near Hennepin are explained by the very different geological history of these two reaches of the stream. The lower Illinois from the bend

southward occupies its pre-glacial channel which formed a drainage outlet for a very much larger area than now drains through this portion of the river. There is circumstantial evidence that the Rock River, now a tributary of the Mississippi, at one time entered the Illinois near the Great Bend, and was subsequently diverted by glacial action. This enlarged drainage area and the great volumes of water that poured from the glaciers serve to account for the wide and deep river valley that was excavated. In places, the prehistoric stream reached a width not less than 15 miles.

The present valley, from the Great Bend east, is of more recent origin and owes its existence to its temporary occupancy by the drainage from the glacial Lake Chicago. As stated by Leverett:

"This portion of the Illinois Valley, although of Post-Wisconsin age, has a channel of more than a mile in average width and nearly 100 feet in average depth. Yet at present it is the line of discharge for an area of only 12,000 square miles. This influence of the waters discharged from the Lake Chicago and also from the Lobes north and east of the Kankakee is plainly shown in the great size of this valley."

In the escape of these waters it was necessary to cut through a glacial moraine near Marseilles, which for a considerable time, no doubt, impounded a large lake in that part of the river adjacent to Morris. Below the Marseilles Moraine, the channel was cut to a depth of 50 to 75 feet, and is still cutting, the river running upon a rock bottom.

The great quantities of debris brought down by the glacial floods were deposited in the wide and deep valley of the lower Illinois; also, no doubt the scour from the cutting in the upper Illinois. The recession of the glaciers and the resulting diminished floods, particularly, the new outlet formed for the Great Lakes waters at Niagara, a comparatively recent geological event, greatly diminished the water supply and the filling of the Illinois Valley was not so far advanced as other streams of the Middle West; it remains today only partially filled, with the thread of the stream running substantially straight in its pre-glacial-channel, flanked by numerous lakes and lagoons which doubtless would have been largely obliterated but for the important changes in water supply heretofore mentioned.

The building up of the bottom has continued in recent times and is going on today, but the rate of filling is much diminished by the decreased water supply and consists of the finer silt only, which when the flood invades the bottom lands is quickly dropped in the slackened waters and thus accounts for the height of the banks immediately adjoining the stream and the general slope of the land away from the river bank toward the inland lakes. The filling of the lakes is now very slow as much of the water borne material is dropped immediately outside the thread of the channel.

In the upper river, although deposits of considerable magnitude took place in the Morris Basin, the more recent period has been one of cutting only. The deposits brought down by the tributaries were largely cut away in the drainage of the Morris Basin, and on account of the more rapid fall in this part of the river, the cutting continues to a relatively small extent. In the lower river the cutting is absent and

the bottoms are building, although slowly, by reason of the diminished water supply.

WATERWAY IMPROVEMENT IN THE ILLINOIS VALLEY.

The Illinois-Michigan Canal, opened to traffic in 1848 was soon considered inadequate for the rapidly developing commerce. The lower Illinois was found too shallow for the boats that would ply the stream. The State built the dams at Henry (completed 1871) and Copperas Creek (completed 1877), and the Federal government at LaGrange (completed 1899) and Kampsville (completed 1893) after years of discussion and numerous surveys and reports by the engineers of the U. S. War Department. Water from Lake Michigan to increase the low water flow of the Illinois River for navigation purposes has been considered necessary since the opening of the Illinois-Michigan Canal. A Ship Canal or "Deep Waterway" has been the dream of the Illinois Valley Commercial and Industrial interests for more than half a century. Through waterway conventions and general public demand, a deep waterway via the Illinois and the Mississippi Rivers, has been continuously before the Congress of the United States and the Legislature of Illinois. More general studies have been made and detailed information obtained regarding the Illinois River Valley than for any other stream of equal length in the United States.

Early surveys were made by the U. S. War Department Engineers on which were based the reports resulting in the construction of the Illinois-Michigan Canal and the four dams in the lower river.

The demand for the "Deep Waterway" through the Illinois River after the construction of the Chicago Sanitary and Ship Canal to a navigable depth of 22 feet, resulted in the "Survey and Report on a 14-foot Waterway from Lockport to St. Louis via the DesPlaines, Illinois and Mississippi Rivers" by the engineers of the U. S. War Department by direction of Congress. The surveys were made in 1902-1904, and report published in 1905 as House Document No. 263, Fifty-ninth Congress, First Session.

This report included (1) topographic survey of the overflowed lands of the Illinois River Valley, and maps with contour lines at one-foot intervals; (2) river channel soundings; (3) high water and low water elevations; (4) permanent triangulation stations and bench marks for future surveys; (5) compilation of all available river gage readings along the Illinois River; (6) discharge measurements of the Illinois River at a number of stations where long records of river stages had been kept; (7) established river gages during the progress of the survey at many points intermediate to the gages that had been previously kept; (8) maps and profiles disclosing the results of the surveys and data collected, and (9) plans and estimates for a deep waterway. In short, this survey and report is a compilation of all the available survey and hydraulic data and has since been used as the basis for subsequent study and plans.

Recently, under direction of Congress, re-surveys of the Illinois River channel have been made by the U. S. War Department Engineers

for construction of a nine-foot waterway from Utica to St. Louis, report dated May 11, 1928, House Document No. 12, Seventieth Congress, First Session, Committee on Rivers and Harbors.

Meanwhile, the State of Illinois is constructing a nine-foot water-wayway from Lockport to Utica with mitre-sills 14 feet below water level to be completed and open for traffic in 1931.

SOURCES OF INFORMATION.

Sources of information referred to or used in these studies include reports of U. S. Weather Bureau, United States Geological Survey, U. S. War Department Engineers and by several Departments of the State of Illinois, among which are the following:

1. Report of the Illinois State Board of Health on the sanitary conditions of the Illinois River with special reference to the effect of the sewage of Chicago, prior to and after the opening of the Sanitary Canal, published 1901.

2. Report of the U. S. War Department Engineers on the 14-foot waterway from Chicago to St. Louis by way of the Illinois River, House Document 263, Fifty-ninth Congress, First Session, 1905.

3. Report of the Internal Improvement Commission of Illinois for a "Waterway from Lockport, Illinois, by way of the DesPlaines and Illinois Rivers," 1909.

4. Report of the Rivers and Lakes Commission of Illinois giving river discharge measurements, river stages, etc., of the Illinois River and its tributaries and other streams in the State, prior to and including the year 1911, published in 1914.

5. Report of Rivers and Lakes Commission of Illinois, prepared by Alvord & Burdick, on "The Illinois River and its Bottom Lands, with reference to the Conservation of Agriculture and Fisheries and the Control of Floods," 1915.

6. The Illinois State Geological Survey Report on "The Drainage Districts of Illinois," Bulletin No. 42, published 1921.

7. Report of the Division of Waterways, by M. G. Barnes, Chief Engineer, on "Flood in Illinois in 1922."

8. Report of the engineers, U. S. War Department, on "Flood Control of Illinois River," 1924, House Document 276, Sixty-eighth Congress, First Session.

9. Gauge readings and discharge measurements by the engineers of the Sanitary District of Chicago.

10. The U. S. Weather Bureau climatological reports of daily rainfalls at the stations where records have been kept in Illinois, Indiana and Wisconsin, on and adjacent to the Illinois River watershed, furnish the information on which are based the rainfall studies herein discussed.

Since 1908 the United States Geological Survey has been co-operating with the State of Illinois in making discharge measurements and keeping gauge records of the Illinois River and its tributaries. This co-operation was begun under the Rivers and Lakes Commission and has been followed by the Division of Waterways since the merging of the work of the Rivers and Lakes Commission with that Division.

Based on these discharge measurements, the United States Geological Survey has prepared rating curves, and from river gauge readings daily discharges have been tabulated for practically all of the gaging stations on the Illinois River and its tributaries since this co-operative work was undertaken. These discharge measurements are published from year to year in the United States Geological Survey Water Supply Papers Series.

The Illinois State Geological Survey and the United States Geological Survey have been co-operating for a number of years in mapping the State of Illinois. This work has progressed to a point where a large part of the Illinois River watershed has been surveyed and maps made showing drainage and elevations by contours at intervals of ten (10) feet on maps drawn to a scale of about one inch, per mile. These maps show the locations of buildings, roads and other public improvements, and the topographic features essential to the development of preliminary plans for drainage and flood control works.

RIVERS AND LAKES COMMISSION REPORT, 1915 (BY ALVORD AND BURDICK.)

This report shows that by the year 1914 levees had been built in the Illinois River Valley, reclaiming about 150,000 acres of the overflowed land, and levees were then in process of construction for reclaiming about 20,000 additional acres, or a total of 170,000 acres. The rainfall from 1890 to 1900 was below normal and from 1900 to 1910 was above normal. The greater rainfall and the diversion from Lake Michigan through the Chicago Sanitary and Ship Canal, together with leveeing of nearly 50 per cent of the overflowed lands in the Illinois River Valley caused much higher flood stages and more frequent overflow. The questions to which that report was addressed are as follows:

1. "What future flood rates may reasonably be expected on the Illinois River?

2. "Is the present waterway sufficient to accommodate the future floods?

3. "What interests are affected by the past and probable future improvements in the valley? How is each interest affected and what is the relative importance of each?

4. "What plan can be followed to correct the deficient waterway and to produce a maximum benefit to the local interests and to the public?"

Among the conclusions and findings we would note particularly, as bearing upon the present flood situation in the Illinois Valley, the following:

1. "PAST FLOODS.—We conclude that the flood of 1904, which at most places upon the river is the greatest flood of recent years, reached the rate of about 80,000 c. f. s. at Peoria and 125,000 c. f. s. at the mouth of the river. These rates are equivalent, respectively, to 5.94 and 4.48 c. f. s. per square mile of drainage area.

"At nearly all places upon the river the flood of 1844 reached a greater height than any flood of record before or since. This flood occurred during the maximum flood upon the Mississippi, and the water passed through a river valley entirely unimproved, very likely a veritable

jungle. Under all these circumstances, it is questionable if the flow rates in the 1844 flood very much exceeded those in 1904."

2. "Present Waterway.—In a state of nature the river in flood occupied its entire valley from hills to hills. For many miles in the lower river this flood plane averaged three miles in width and in the great floods from seven to nine feet in depth.

"In the lower one-third of the river, farm land levees have reduced the width of the flood plane by about 80 per cent and have reduced the cross-section of the flowing stream in a great flood to about 25 per cent of the available cross-section of the 1904 flood.

"Although a large part of the flood flow has always passed by way of the channel, the velocity being comparatively slow upon the land, it is our conclusion that the farm land levees are a menace to themselves, in that they have so restricted the flood water channel and are lacking in height, generally speaking, to such an extent that they are likely to be overtopped in a great flood. As the protection afforded to different districts is quite variable, it is evident that the lowest levees will suffer first and will tend to protect the higher levees. If all the districts are to be protected, a greater available flood cross-section must be provided which may be accomplished in several ways, or the flood rates must be reduced through storage."

3. "Interest Affected.—Although many interests are affected to a minor degree, we find that the predominant interests in the river valley are agriculture and fishing. There are other important interests at Peoria and at a few of the other cities bordering the stream. These cities, however, without important exceptions are well above the ordinary floods and the municipalities in general are not greatly concerned with flood abatement."

4. "Flooded Lands.—We estimate the total water acreage below LaSalle in the flood of 1844 at 397,980 acres. Of this acreage 320,150 acres was flooded land. The first total includes 28,490 acres of river surface and 49,340 acres of lakes adjoining the river, the river and lakes surface being measured at the low water plane in 1901."

5. "Levee Districts.—Since 1904 the construction of levees for the protection of the bottom lands has proceeded at a rapid rate. At the present time nearly all the bottom land below Beardstown has been reclaimed. The total leveed lands are estimated at 171,725 acres. These lands have been protected from floods at an estimated cost of $5,350,000, or about $30.00 per acre. The estimated full value of these lands is about $19,000,000, an average of about $112.00 per acre. Much of this land is valued at from $125.00 to $150.00 per acre."

LEVEE DISTRICTS IN THE ILLINOIS VALLEY.

Considerable areas of the higher lands in the overflowed portion of the Illinois Valley had been cleared and put into cultivation prior to the waterway survey for the 14-foot waterway by the U. S. Engineers in 1902 to 1904. Levees had been constructed in the lower Illinois Valley by three organized drainage districts and by five private owners, as follows:

Organized Districts, 1904.	Acres.	
1. Pekin & LaMarsh District, opposite Pekin	2,300	
2. Lacey (and Langellier) District, opposite Havana	5,100	
3. Coal Creek Drainage District, opposite Beardstown	6,700	
		14,100 Acres
Private Levees, 1904.		
1. Kaiser or Roberts Ranch, below Pearl	3,300	
2. Hartwell Ranch, below Pearl	5,500	
3. Keach Ranch, below Pearl	1,200	
4. Spankey, below Kampsville	900	
5. Rosedale, below Hardin	285	
		11,185 Acres
Total		25,285 Acres

The Pekin and LaMarsh District, Lacey District and private levees were all overflowed in 1904, and only the Coal Creek District was protected against the 1904 high water.

Since 1914 a number of additional levee districts have been organized and constructed and there are now remaining six (6) areas along the Illinois River that might be leveed for agricultural purposes or for flood peak storage, located as follows:

1. Meredosia Lake Region, about	8,000 acres
2. The Delta of the Sangamon River from Bath to Beardstown, about	40,000 acres
3. Waukanda District, immediately below Liverpool, about	6,000 acres
4. East side of the river, from Spring Bay to the Sante Fe Railway, opposite Chillicothe, about	6,000 acres
5. Sparland District, about	2,500 acres
6. Lake Senachwine Basin, about	12,000 acres
Total	74,500 acres

The Hennepin District on the east side of the river, just below Hennepin, containing about 3,000 acres, is the only effective levee district between Peoria and LaSalle. The levees of the Partridge District, opposite Chillicothe, were destroyed by wave action and the district has been abandoned. The Chautauqua Drainage District, containing about 3,500 acres, just above Havana and opposite Liverpool, was overflowed in 1926 and the levees have not been repaired. This district would add about 3,500 acres to the overflowed area available for flowage and storage if the levees are not restored.

The entire area of the lower Illinois Valley subject to overflow, from LaSalle to the mouth, was about 400,000 acres, of which about 70,000 acres was water surfaces in river channel and lakes, the land subject to overflow being about 330,000 acres.

The area of levee districts completed, or under construction in 1914, was about 150,000 acres. Shortly thereafter additional levees were completed covering about 18,000 acres, or a total of about 168,000 acres.

There are now 38 active organized levee districts and three private levees enclosing about 200,000 acres of Illinois River bottom lands leveed. There are also several districts lying near the foot-hills, organized to protect the land from overflow of the tributary streams, and to some extent from back-water of the Illinois River. Tables, No. 1 to No. 4, inclusive, are a list of the levee districts giving the name of the district, the county in which the district is located, the area, cost of improvements and other statistical data.

From LaSalle to its mouth the flood plane of the Illinois River is from one mile to seven miles wide, generally ranging from two to four miles in width, and is divided by deltas of the tributary streams into four distinct reaches, which are most conveniently designated, as follows:

1. From LaSalle to Peoria, containing about 53,000 acres of bottom land, subject to overflow, in which there is one effective levee district just below Hennepin of 2,610 acres. Levees were constructed to reclaim about 3,000 acres opposite Chillicothe by the Partridge District, but these levees have been destroyed by wave action and the work abandoned.

2. From Peoria to Havana, containing about 51,000 acres of bottom land, subject to overflow, of which about 37,000 acres is in nine (9) organized levee districts and about 14,000 acres not leveed.

3. From Havana to Beardstown, containing about 63,000 acres of bottom land subject to overflow, including the delta of the Sangamon River, of which about 19,240 acres is in nine (9) organized levee districts and about 43,760 acres not leveed.

4. From Beardstown to Grafton, containing about 166,000 acres of bottom land subject to overflow, of which about 130,000 acres is in nineteen (19) organized levee districts and about 36,000 acres not leveed. Of the 36,000 acres not leveed, 31,000 acres lie between the last levee district and the mouth of the river.

It will be noted that 4 per cent of the bottom lands subject to overflow, between LaSalle and Peoria, has been leveed, about 73 per cent between Peoria and Havana has been leveed, about 30 per cent between Havana and Beardstown has been leveed and about 78 per cent between Beardstown and Grafton has been leveed, or 95 per cent of the latter area has been leveed between Beardstown and the lower end of the last levee district.

The levees have reduced the space available for flow and for storage, which has the effect of increasing flood stages.

TABLE NO. 1—DRAINAGE DISTRICT STATISTICAL DATA, ILLINOIS RIVER VALLEY.

No.	Name of district.	County.	Year organized.	Areas.			Levee.			Ditches.	
				In district.	Assessable.	Cultivated.	Year completed.	Miles.	Elev. grade M. D.	Miles open.	Miles main tile.
1	Hennepin	Putnam	1909	2,900	2,585	2,500	1913	6.0	465	7.0	20
2	East Peoria	Tazewell	1907	800	736	250	--------	1.75	463	2.5	--------
3	Pekin-LaMarsh	Peoria	1888	3,010	2,674	2,674	--------	6.64	464	4.5	3.4
4	Rocky Ford	Tazewell	1911-12	1,615	1,400	1,565	--------	4.35	462	2.34	5.78
5	Spring Lake	Tazewell	1903	13,120	12,000	11,850	1910	15.8	460-464	30.0	30.0
6	Banner Special	Peoria and Fulton	1910	4,561	4,279	4,561	--------	10.6	461	10.0	1.0
7	East Liverpool	Fulton	1916	3,300	2,765	2,600	--------	7.1	459-460	7.2	2.0
8	Liverpool	Fulton	1916-23	3,300	3,024	3,000	--------	5.99	459	5.5	7.88
9	Chautauqua	Mason	1918	3,800	3,500	3,500	--------	9.47	------------	10.5	--------
10	Thompson Lake	Fulton	1918-21	6,000	5,600	5,400	--------	13.5	457-458	15.0	50.0
11	Crabtree (private)	Fulton	----------	1,200	1,000	1,000	--------	5.48	------------	5.0	--------
12	Spoon River (private)	Fulton	----------	2,200	2,200	2,100	--------	3.79	453-459	2.0	2.7
13	Lacey	Fulton	----------	3,500	2,987	2,987	1893	4.3	459-460	6.5	--------
14	Langellier	Fulton	----------	2,200	1,978	1,800	1893	2.03	459	0.5	8.2
15	West Matanzas	Fulton	1913	3,000	2,678	2,400	--------	6.0	458-459	8.0	25.0
16	Seahorn	Fulton	1919	1,820	1,471	1,471	1914	5.5	458	3.0	3.75
17	Kerton Valley	Fulton	1917	2,024	1,741	1,741	--------	2.75	458	5.6	3.0
18	Big Lake	Schuyler	1905	3,400	3,150	3,150	--------	7.0	------------	12.0	18.0
19	Kelly Lake	Schuyler	1916	1,280	985	985	--------	4.58	458	2.2	8.0
20	Coal Creek	Schuyler	1895	6,718	6,290	6,390	1898	10.1	457	10.0	12.0
21	Lost Creek	Cass	1920	2,540	2,400	2,400	--------	3.1	455	7.3	1.0
22	Crane Creek	Schuyler	1908	5,500	5,050	4,900	1911	8.1	454	9.9	2.6
23	South Beardstown	Cass	1913	8,500	7,313	7,200	--------	12.0	456	13.0	12.0
24	Valley	Cass	1914	3,200	3,030	2,940	--------	1.94	454	12.8	0.5
25	Big Prairie	Brown	1916	1,880	1,700	1,500	--------	5.4	455	3.8	25.0
26	Meredosia Lake	Cass and Morgan	1904	4,000	3,700	3,610	--------	5.02	454	5.83	--------
27	Willow Creek	Morgan	1893	4,213	4,213	3,980	--------	6.0	------------	4.0	--------
28	Little Creek, Kerr and Kerr-Crane	Brown	1920	1,800	1,700	1,300	--------	6.0	452	4.0	10.0
29	McGee Creek	Pike and Brown	1906-07	10,800	10,080	9,000	1910	11.45	451	16.5	--------
30	Coon Run	Morgan and Scott	1902	4,500	4,250	4,010	--------	8.5	------------	--------	4.7
31	Oakes (private)	Scott	1869-1908	550	------------	400	--------	1.5	------------	0.5	--------
32	Mauvaisterre	Scott	1902	4,040	3,980	3,980	--------	5.26	452	7.0	0.7
33	Scott County	Scott	1909	10,000	9,200	9,200	1914	13.26	452	14.1	3.0
34	Valley City	Pike	1920	5,000	4,750	3,200	1922	5.6	450-451	8.5	0.75
35	Big Swan	Scott	1903	12,000	11,850	11,850	1906	12.0	450	15.25	4.0
36	Hillview	Scott and Green	1906	12,900	12,318	12,300	1909	12.1	446	32.0	1.0
37	Hartwell	Greene	1906	8,900	8,650	8,650	1910	12.1	446	14.1	--------
38	Keach	Greene	1922	8,400	8,000	7,000	--------	26.2	446	8.4	--------

39	Eldred	Greene	1909	10,548	8,460	9,500	1912	20.0	445	9.46	
40	Spanky	Greene	1917	875	825	815		2.75		2.5	
41	Nutwood	Jersey	1907	11,300	10,860	10,360	1910	14.0	443-444	30.0	1.25
42	Hager Slough*	Cass	1921	3,700	3,500	3,500		7.0		8.0	
43	Griggs Chapel*										

* District on second bottom land at mouth of Sangamon not leveed, but probably will be and reduce present high-water storage.

No. 1. NOTE.—There are several small levee districts and private levees near the foothills at the edge of the valley which were flooded in 1926, but their areas do not materially affect flood stages.

No. 2. NOTE.—The value of improvements, estimated yields and crop values, and annual expenses were obtained from statements of landowners and district officers.

No. 3 NOTE.—Where values were not given by owners or officers the value of land was set at $100.00 per acre.

No. 4. NOTE.—Elevations for top of levee represent the approximate average effective grade of levees in 1929.

TABLE NO. 2—DRAINAGE DISTRICT STATISTICAL DATA, ILLINOIS RIVER VALLEY.

No.	Name of district.	County.	Highway.			Railroad.	Population.			Principal crops. Average annual yield per acre.			
			Miles graded.	Miles graveled.	Miles paved.	Miles in district.	Dwelling houses.	Resident.	Non-resident.	Corn, bushels.	Wheat, bushels.	Oats, bushels.	Hay, tons.
1	Hennepin	Putnam	9.6				5	10	50	60	25		
2	East Peoria	Tazewell	14.5		3.5	2.5	253	1,000	175	50	30	30	
3	Pekin-LaMarsh	Peoria	4.6		1.6	5.6	9	22	30	55	30	40	
4	Rocky Ford	Tazewell	0.5				1	4	25	60	25	55	
5	Spring Lake	Tazewell		1.5			69	280	65	55	25	45	
6	Banner Special	Peoria and Fulton					9	19	65	60	30	50	
7	East Liverpool	Fulton	1.5					22	15	60	20		
8	Liverpool	Fulton	2.4					4	41	60	25		
9	Chautauqua	Mason						12	10	60	30	35	
10	Thompson Lake	Fulton	8.0				15	50	200	60	25	50	2
11	Crabtree (private)	Fulton					1		4	50	30	50	
12	Spoon River (private)	Fulton					6	40	85	50	25	40	2
13	Laccy	Fulton	2.0				4	10	6	50	22	40	
14	Langellier	Fulton					2			50	30		
15	West Matanzas	Fulton					10	16		50	20		
16	Seahorn	Fulton	2.0				9	42	40	50	30	30	
17	Kerton Valley	Fulton					10	48	10	50	30	40	
18	Big Lake	Schuyler	6.0				9	30	100	55	28	50	
19	Kelly Lake	Schuyler	8.0				1	3	22	70	30	50	2
20	Coal Creek	Schuyler	4.0		4.0	3.5	17	41	30	55	32	45	
21	Lost Creek	Cass	0.9		1.5	1.0	13	80	14	62	30	35	
22	Crane Creek	Schuyler	8.5				26	130	84	50	25	35	
23	South Beardstown	Cass	23.0				38	190	45	50	25	35	2
24	Valley	Cass	12.0				20	80	20	50	25	35	
25	Big Prairie	Brown	2.3				5	35	12	65	30		
26	Meredosia Lake	Cass and Morgan	12.0				25	105	55	50	25	35	2
27	Willow Creek	Morgan	5.5				17	56	58	50	25	45	1.5
28	Little Creek, Kerr and Kerr-Crane	Brown	4.0				15	50	30	55	26		2
29	McGee Creek	Pike and Brown	12.0			4.5	25	128	75	60	25	30	
30	Coon Run	Morgan and Scott	7.5				18	80	31	55	28	50	
31	Oakes (private)	Scott	2.0			1.25	1	5	4	50	30		
32	Mauvaisterre	Scott	9.1			2.7	16	80	64	30	22	20	2.5
33	Scott County	Scott	15.0				55	275	45	55	25	55	2.5
34	Valley City	Pike	11.0				18	48	40	50	25		2.5
35	Big Swan	Scott	25.0		3.25		85	270	10	50	27	40	

36	Hillview	Scott and Greene	7.0			4.0	50	250	35	50	25	35	
37	Hartwell	Greene					20	100	90	50	20	40	2
38	Keach	Greene					30	125	20	35	20	30	
39	Eldred	Greene				9.0	36	158	57	40	20		
40	Spanky	Greene	1.25				2	5	30	30	20	30	2.5
41	Nutwood	Jersey	20.0		6.0	7.0	98	392	18	55.	27	38	

TABLE NO. 3—DRAINAGE DISTRICT STATISTICAL DATA, ILLINOIS RIVER VALLEY.

No.	Name of district.	County.	Estimated property value.			Year breaks occurred.	Damage to farm improvement.	Cost of repairs and enlargement since 1922—Levee and ditches.
			Per acre.	Improvements.	Total.			
1	Hennepin	Putnam	$ 75.00	$ 41,500 00	$ 225,000 00			
2	East Peoria	Tazewell		(Industrial	860,000 00 and Residential)	1927	$ 2,000 00	$ 42,568 65
3	Pekin-LaMarsh	Peoria	175 00	10,600 00	420,000 00	1926–27	16,000 00	82,000 00
4	Rocky Ford	Tazewell	100 00	5,000 00	166,500 00			20,000 00
5	Spring Lake	Tazewell	125 00	165,000 00	1,625,000 00			95,291 00
6	Banner Special	Peoria and Fulton	70 00	13,800 00	322,000 00	1926	34,700 00	13,784 92
7	East Liverpool	Fulton	100 00		330,000 00	1926–27	20,250 00	45,435 80
8	Liverpool	Fulton	100 00		330,000 00			7,500 00
9	Chautauqua	Mason	100 00		380,000 00	1926	6,500 00	
10	Thompson Lake	Fulton	50 00	73,000 00	215,000 00	1922		150,000 00
11	Crabtree (private)	Fulton	100 00	1,000 00	121,000 00	1926	3,700 00	1,000 00
12	Spoon River (private)	Fulton	125 00	11,800 00	212,500 00	1926	600 00	
13	Lacey	Fulton	150 00	15,300 00	450,000 00	1926	23,500 00	47,922 00
14	Langellier	Fulton	150 00	2,200 00	220,000 00	1926	31,000 00	30,000 00
15	West Matanzas	Fulton	100 00	14,000 00	314,000 00	1926	21,300 00	23,694 00
16	Seahorn	Fulton	100 00	45,250 00	227,250 00			20,400 00
17	Kerton Valley	Fulton	37 50	49,000 00	150,000 00	1926–27	7,100 00	7,300 00
18	Big Lake	Schuyler	100 00	41,000 00	381,000 00	Not flooded		100,000 00
19	Kelly Lake	Schuyler	100 00	2,250 00	130,250 00	1923 & 1926	1,800 00	24,000 00
20	Coal Creek	Schuyler	150 00	74,900 00	1,000,000 00	1922		167,000 00
21	Lost Creek	Cass	100 00	47,585 00	301,585 00	1922 & 1926		10,960 00
22	Crane Creek	Schuyler	150 00	94,000 00	919,000 00	1922		112,327 00
23	South Beardstown	Cass	135 00	114,560 00	1,674,560 00			138,000 00
24	Valley	Cass	75 00	51,900 00	233,000 00			52,500 00
25	Big Prairie	Brown	100 00	24,800 00	212,800 00			15,000 00
26	Meredosia Lake	Cass and Morgan	125 00	98,600 00	125,000 00	1926	500 00	65,000 00
27	Willow Creek	Morgan	100 00	51,450 00	472,750 00	1926		500 00
28	Little Creek, Kerr and Kerr-Crane	Brown	100 00	25,000 00	205,000 00	1926–27		31,000 00
29	McGee Creek	Pike and Brown	125 00	24,400 00	1,410,000 00	1926	70,500 00	369,000 00
30	Coon Run	Morgan and Scott	100 00	43,700 00	493,700 00	1926		72,000 00
31	Oakes (private)	Scott	100 00	2,250 00	57,250 00	1926		
32	Mauvaisterre	Scott	100 00	62,000 00	183,000 00	1926		100,000 00
33	Scott County	Scott	100 00	138,950 00	1,000,000 00	1926	23,500 00	195,000 00
34	Valley City	Pike	100 00	40,900 00	540,900 00	1926	18,430 00	30,000 00

35	Big Swan	Scott	125 00	332,000 00	1,550,000 00	1926	30,100 00	77,000 00
36	Hillview	Scott and Greene	125 00	230,000 00	1,550,000 00	1926	21,000 00	245,700 00
37	Hartwell	Greene	75 00	88,000 00	712,000 00			323,300 00
38	Keach	Greene	100 00	71,000 00	911,000 00	1926	3,850 00	155,100 00
39	Eldred	Greene	125 00	64,450 00	1,190,000 00			99,100 00
40	Spanky	Greene	100 00	16,800 00	97,000 00			13,600 00
41	Nutwood	Jersey	100 00	318,400 00	1,100,000 00			112,100 00

NOTE.—The cost of repairs and enlargement of levees and ditches since 1922 does not include cost of work provided for by State appropriations.

TABLE NO. 4—DRAINAGE DISTRICT STATISTICAL DATA, ILLINOIS RIVER VALLEY.

No.	Name of district.	County.	Cost of district.					
			Amount paid in cash.	Total assessments.	Total bond issues.	Outstanding bonds.	Total cost per acre.	Bonded indebtedness per acre.
1	Hennepin	Putnam	$100,000 00	$292,000 00	$192,000 00	$ 92,000 00	$113 00	$ 35 00
2	East Peoria	Tazewell	42,568 65	124,643 65	82,075 00	41,572 00	117 00	56 40
3	Pekin-LaMarsh	Peoria	50,000 00	144,735 00	94,735 00	85,000 00	54 00	32 00
4	Rocky Ford	Tazewell	39,000 00	225,750 00	186,750 00	186,750 00	161 00	133 50
5	Spring Lake	Tazewell	108,000 00	970,256 65	862,256 65	332,500 00	81 00	27 70
6	Banner Special	Peoria and Fulton	116,300 00	499,300 00	383,000 00	254,500 00	116 00	59 50
7	East Liverpool	Fulton	143,100 00	383,100 00	240,000 00	192,900 00	139 00	70 00
8	Liverpool	Fulton	(None)	197,000 00	197,000 00	177,000 00	65 00	58 50
9	Chautauqua	Mason	37,000 00	264,685 00	227,685 00	196,000 00	79 00	56 00
10	Thompson Lake	Fulton	131,935 00	420,935 00	289,000 00	144,500 00	75 00	26 00
11	Crabtree (private)	Fulton	24,000 00	24,000 00	(None)	(None)	24 00	(None)
12	Spoon River (private)	Fulton						
13	Lacey	Fulton	204,500 00	204,500 00			68 00	
14	Langellier*	Fulton		30,000 00	30,000 00	30,000 00	46 50	15 00
15	West Matanzas	Fulton	50,000 00	270,000 00	220,000 00	196,000 00	101 00	73 00
16	Seahorn	Fulton	75,000 00	130,000 00	55,000 00	43,000 00	88 00	29 00
17	Kerton Valley	Fulton	63,900 00	146,900 00	83,000 00		83 00	
18	Big Lake	Schuyler	30,000 00	250,000 00	220,000 00	60,000 00	79 00	19 00
19	Kelly Lake	Schuyler	61,000 00	165,300 00	104,300 00	59,600 00	168 00	60 50
20	Coal Creek	Schuyler		349,656 00	349,656 00	196,255 00	55 00	30 60
21	Lost Creek	Cass	26,292 00	107,292 00	81,000 00	27,000 00	45 00	11 00
22	Crane Creek	Schuyler	25,000 00	271,950 00	246,950 00	104,420 00	54 00	20 50
23	South Beardstown	Cass	198,000 00	753,000 00	555,000 00	373,000 00	103 00	51 00
24	Valley	Cass	36,570 00	117,570 00	81,000 00	31,900 00	39 00	10 50
25	Big Prairie	Brown	35,000 00	141,000 00	106,000 00	72,000 00	83 00	42 50
26	Meredosia Lake	Cass and Morgan	66,700 00	195,000 00	128,300 00	39,000 00	53 00	10 50
27	Willow Creek	Morgan	30,000 00	130,000 00	100,000 00		31 00	
28	Little Creek, Kerr and Kerr-Crane	Brown	125,000 00	125,000 00			73 00	
29	McGee Creek	Pike and Brown	124,000 00	767,500 00	643,500 00	248,000 00	76 00	24 80
30	Coon Run	Morgan and Scott	81,000 00	102,000 00	21,000 00	11,000 00	24 00	2 50
31	Oakes (private)	Scott		2,500 00	2,500 00			
32	Mauvaisterre	Scott	69,000 00	121,000 00	52,000 00	44,000 00	30 00	10 10
33	Scott County	Scott	146,000 00	446,000 00	300,000 00	117,000 00	48 00	12 70
34	Valley City	Pike	34,000 00	422,000 00	388,000 00	388,000 00	89 00	82 00
35	Big Swan	Scott	141,400 00	439,800 00	298,400 00	108,600 00	37 00	9 00
36	Hillview	Scott and Greene	149,600 00	763,700 00	614,100 00	258,000 00	62 00	21 00

37	Hartwell	Greene	93,000 00	653,000 00	560,000 00	312,000 00	75 00	36 00
38	Keach†	Greene	52,800 00	207,600 00	155,100 00	154,000 00		19 30
39	Eldred	Greene	40,500 00	461,800 00	421,300 00	246,900 00	55 00	29 20
40	Spanky‡	Greene	4,980 00	42,810 00	37,830 00	23,560 00		28 60
41	Nutwood	Jersey	10,000 00	445,900 00	435,900 00	131,500 00	41 00	12 10

* District private before 1925—amount of expenditure unknown.
† District private before 1922—amount of expenditure unknown.
‡ District private before 1917—amount of expenditure unknown.

AERIAL PHOTOGRAPHS OF THE 1926 FLOOD OF THE ILLINOIS RIVER.

At the height of the flood of 1926, October 14 and 15, the Division of Waterways procured a series of aerial photographs covering the Illinois from Peoria to Naples. These photographs illustrate more clearly than any other means the extent of the flooded area and the levee districts which were overflowed. Several of the photographs illustrative of the conditions, and which show some of the critical reaches of the Illinois River, are reproduced:

Picture No. 1 (Record No. 4791) October 14, 1926, is a view looking up the Illinois River from a point just above Pekin showing the overflowed valley with Bartonville and Peoria in the distance. The bend of the river at the lower end of the city of Peoria, and the extent of the overflowed area covered by timber are clearly shown. At the lower left hand corner of the picture is shown the upper end of the levee of the Tuscarora Drainage and Levee District, an extension of the Pekin and LaMarsh levee.

PICTURE NO. 1.

Looking up the Illinois River just above Pekin.

Picture No. 2 (Record No. 4709) October 14, 1926, is a view looking northwest showing the levee at the south end of the Chautauqua Drainage District on the east side of the river, about four miles above Havana, and the Thompson Lake District in the background on the west side of the river. This view shows the Chautauqua District flooded with the water near the top of the levee and crevasses thru which the water is flowing. This indicates that after the Chautauqua Drainage District levees broke there was a very considerable flow thru the area of the district.

PICTURE NO. 2.

Looking northwest about 4 miles above Havana.

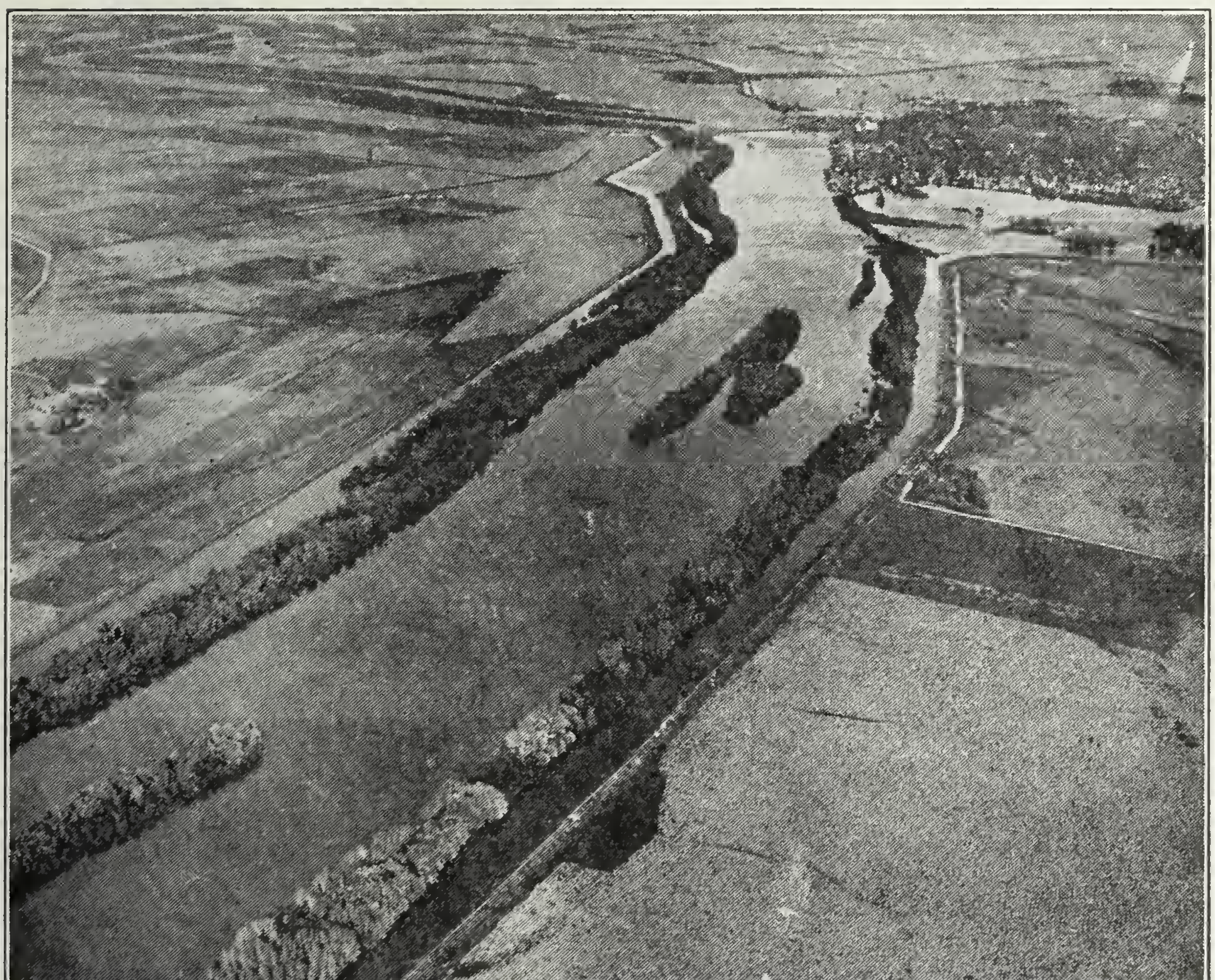
Picture No. 3 (Record No. 4765) October 14, 1926, is a view looking northeast with a portion of the city of Beardstown in the lower right hand corner. The Lost Creek Levee District in the center foreground and a large area of developed farm lands on the second bottoms north of Beardstown, which are not overflowed until the river passes a stage of 20 feet on the Beardstown gage.

PICTURE NO. 3.

Looking northeast of Beardstown.

Picture No. 4 (Record No. 4759) October 14, 1926, is a view looking up-stream showing the river channel, Coal Creek Levee District and the South Beardstown Levee District levees, the open borrow pits along the levees, the heavy fringe of timber between the river channel and the borrow pits, with Beardstown in the upper right hand corner background. Attention is directed particularly to the heavy growth of timber along the river bank, which is relied upon by the districts to protect the levees from erosion by wave action.

PICTURE NO. 4.



Looking Upstream above Beardstown showing River Channel.

Picture No. 5 (Record No. 4754) October 14, 1926, is a view looking up-stream with the LaGrange Locks and Dam at the left center, showing the overflowed area opposite the locks, with Meredosia Lake Drainage and Levee District in the upper right hand corner and the South Beardstown Drainage and Levee District in the upper left hand corner. This picture also illustrates the extent of growing timber in the unleveed overflowed area.

PICTURE NO. 5.

Looking Upstream with the La Grange Lock at left center.

Picture No. 6 (Record No. 4747) October 14, 1926, a view looking up-stream shows the city of Meredosia at the right, and in the foreground the Wabash Railroad Bridge, the McGee Creek Drainage and Levee District with the levees broken and district flooded—Meredosia Bay and the overflowed area in the central background, the Meredosia Drainage and Levee District in the right central background, and the South Beardstown Drainage and Levee District in the distant background.

PICTURE NO. 6.

Looking Upstream showing Meredosia at right.

PROFILE OF PRINCIPAL FLOODS.

Drawing, Figure No. 3, shows the high waters of the Illinois River from Grafton to LaSalle for the 1844, 1904, 1922, 1926 and 1927 high waters, and the low waters of 1901 and 1922.

STRAIGHTENING TRIBUTARIES.

The flood stages in the Illinois River are also modified by straightening the channels of the tributaries, thus hastening the discharge of the flood waters into the Illinois Valley. Between the years 1900 and 1910 the Sangamon River channel was straightened for a distance of about 40 miles, ending at the eastern edge of the Illinois Valley. Considerable stream straightening has been done in numerous other portions of the Illinois River watershed. While the effect of stream straightening is to hasten the delivery thru the straightened portion of the channel, there is no available data by which it can be determined with certainty that the discharges or stages of the Illinois River have been increased because of this work.

FLOOD CREST TRAVEL.

An examination of the hydrographs of the Illinois River showing the daily stages at Grafton, Pearl, Beardstown, Havana, Peoria, LaSalle and Morris, from 1890 to 1927, inclusive, discloses that the flood waters from the tributaries below the Sangamon are always discharged ahead of the flood crest above Beardstown. The Mississippi River at Grafton frequently reaches crest stage and is falling by the time the Illinois crest reaches Beardstown.

LEVEE DISTRICTS FLOODED.

In each of the three major floods since 1913, viz., 1922, 1926 and 1927, about one-half of the levee districts were overflowed. In some of these districts the levees were broken at two or more places so the water flowed thru, thus increasing the carrying capacity of the river. All of the districts that were overflowed furnished storage as the river was approaching crest, materially reducing the stage to which the river would otherwise have risen. For the 1926 flood detailed estimates and profiles, appearing later in this report, show the additional rise which would have occurred if the levees had been high enough and had held. Maps have been prepared showing the location of the levee districts in the Illinois Valley as they existed in 1904, Figure No. 4; 1913, Figure No. 5, and 1926, Figure No. 6. On these maps are also shown in colors the districts which were flooded and those which were not flooded.

A record of the drainage districts which were flooded in 1922 and 1926, with the dates so far as available, on which the levees broke is given in Table No. 5.

DIVERSION OF WATER FROM LAKE MICHIGAN.

Water from Lake Michigan has been flowing by gravity thru the Illinois River since 1871 when the summit level of the Illinois-Michigan Canal was lowered by the city of Chicago for sanitary drainage. The outlet for the sewers of Chicago was for the Chicago River which flowed

into Lake Michigan, but the current was not sufficient to cleanse the river. The city of Chicago has always taken its water supply from Lake Michigan and the sewage contaminated the water supply. Because of these conditions the current of the Chicago River was reversed so as to flow from Lake Michigan thru the Illinois-Michigan Canal and the DesPlaines River to the Illinois River. This was accomplished by lowering the summit level of the Illinois-Michigan Canal at the expense of the city of Chicago, which was completed in 1871. Within a few years the sewage increased to such an extent that gravity flow thru the Illinois-Michigan Canal was not enough to cleanse the Chicago River and keep sewage from entering the water supply intakes. In 1881 the Legislature of Illinois required the city of Chicago to erect a pumping plant at the entrance of the canal to the Chicago River at Bridgeport to increase the flow of water from Lake Michigan and cleanse the Chicago River by pumping into the canal. These pumps were put into operation in 1884 and continued until the opening of the Chicago Sanitary and Ship Canal on January 17, 1900. Since that time water has been flowing from Lake Michigan thru the Chicago River, the Chicago Sanitary and Ship Canal and the DesPlaines River into the Illinois.

TABLE NO. 5—LEVEE BREAKS—1922.

No.	District.	Date of break.	Station.	Length.	Date repaired.
1	Atkinson Lake*	No data			
2	Banner Spl	Not flooded			
3	Beardstown City		32+00		Previous to Oct. 1, 1922.
4	Big Lake	Not flooded			
5	Big Prairie	Not flooded			
6	Big Swan	Not flooded			
7	Chambersburg*	No data			
8	Chautauqua		49+16	664′	Previous to Mar. 12, 1923.
	Chautauqua	Apr. 7, 1922	260+23.5	205′	Previous to Mar. 14, 1923.
	Chautauqua		409+22.5	335′	Previous to Mar. 17, 1923.
9	Coal Creek	Apr. 16, 1922	N. 94+46.5	535′	1922.
10	Cook*	Apr. (14 or 15) 1922	13+85.5	127′	Prior to Nov. 8, 1922.
	Cook*		53+71.5	250′	Prior to Nov. 8, 1922.
11	Coon Run	Was all flooded in 1922			
12	Crane Creek	Apr. 20, 1922	197+36.5	597′	
13	Dickson*		76+65		Prior to Nov. 10, 1922.
	Dickson*	Apr. 13, 1922	24+37	57′	
14	Eagle Run*	No data			
15	East Liverpool	Apr. 3, 1922	46+22	230′	Prior to Nov. 15, 1922.
16	East Peoria	Not flooded			
17	Eldred	Not flooded			
18	Fairbanks	Apr. 10, 1922	109+33S	362′	Started previous to Aug. 30, 1922.
19	Hartwell	Apr. 19, 1922	149+63	230′	Temporary fill Sept. 15, 1922.
20	Hennepin	Not flooded			
21	Hillview	Not flooded			
22	Indian Creek*	No data			
23	Kelly Lake	Apr. 14, 1922	182+22	28′	Partly filled Oct. 27, 1922.
	Kelly Lake	Apr. 14, 1922	52+54	232′	
24	Kerr	Apr. 14, 1922	8+72	36′	
	Kerr	Apr. 14, 1922	55+57.5	95′	
25	Kerr Crane	Apr. 14, 1922	128+80	125′	
26	Kerton Valley	Not flooded			
27	Keystone S. & W. Co*	Not flooded			
28	Lacey-Langellier	Not flooded			
29	Liles-Metz*	Probably flooded, but no data			
30	Liverpool	Apr. 1, 1922	Levee not to grade		

TABLE NO. 5—Continued.

LEVEE BREAKS—1922.

No.	District.	Date of break.	Station.	Length.	Date repaired.
31	Lost Creek	Apr. 11, 1922	East levee flooded around end of levee or through C. B. & Q. R. R. tracks at Beardstown.		
32	Lynchburg*	Apr. 13, 1922	No data		
33	Old Mauvaisterre	No data, but was flooded			
34	Mauvaisterre	Apr. 16, 1922	Overtopped Naples C	ity and le	vee south of Smith Lake.
35	McGee Creek	Not flooded			
36	Meredosia Lake	Apr. 19, 1922	63+01	388′	Partly filled Oct. 12, 1922.
37	A. J. Metz*	Flooded but no d	efinite information		
38	Naples City*	Apr. 16, 1922	71+50		
39	Nutwood	Not flooded			
40	Partridge*	Abandoned			
41	Pekin and LaMarsh	Apr. 12, 1922	13+50 (R. R. tracks)	500′	Previous to June 27, 1922.
42	Robley*	Apr. 17, 1922	135+54		Flooded around end.
43	Rocky Ford	Not flooded			
44	Schaeffer*	Apr. 11, 1922	44+27	38′	Previous to Aug. 12, 1922.
45	Schulte*	No data, but was	flooded		
46	Scott Co	Apr. 19, 1922	435+58	144′	Oct. 4, 1922.
47	Seahorn	Not flooded			
48	South Beardstown	Not flooded			
49	Spankey	Apr. 22, 1922	60+32	151′	Previous to Sept. 7, 1926.
50	Spring Lake	Not flooded			
51	Spring Run*	No data			
52	Thompson Lake	Apr. 10, 1922	263+69.5	261′	Previous to Mar. 8, 1923; levee not to grade.
53	Tuscarora*	Built in 1925			
54	Valley	Not flooded			
55	Valley City		Not completed		
56	West Matanzas	Not flooded			
57	Wilson Ranch*	Apr. 17, 1922	34+55.5	164′	Began filling Aug. 1, 1922; working, Aug. 8, 1922.
58	Wolf Creek*	No information a	vailable		
59	Youngs*	No information a	vailable		

* Several small districts, nearly all private, have been included in Table No. 5, which were not included in Tables Nos. 1 to 4.

TABLE NO. 5—Continued.

LEVEE BREAKS—1926.

No.	District.	Date of break.	Station.	Length.	Date repaired.
1	Atkinson Lake*	No data			
2	Banner Special	Previous to Sept. 18, 1926	445+26S	112′	Previous to Feb. 7, 1928.
	Banner Special	Previous to Oct. 18, 1926	421+50S	420′	Previous to Feb. 7, 1928.
	Banner Special	Oct. 6, 1926	225+45S	636′	March, 1928.
	Banner Special		34+40N	200′	March, 1928.
3	Beardstown City	Sept. 3, 1926	32+00	Water ove	rtopped entire levee.
4	Big Lake	Not flooded			
5	Big Prairie	Not flooded			
6	Big Swan	Sept. 3, 1926	Near 100+00E		Previous to Oct. 8, 1927.
	Big Swan	Sept. 3, 1926	W17+00		Previous to Oct. 8, 1927.
	Big Swan	Sept. 8, 1926	582+50		Previous to Oct. 8, 1927.
	Big Swan	Sept. 8, 1926	622+26 to end		Previous to Oct. 8, 1927.
7	Chambersburg*	Not known	6 breaks between station 16+45 and 62+82	587′	Previous to June 1, 1928.
8	Chautauqua (1)	Oct. 9, 1926	313+00.7	440′	Not filled Mar. 1, 1929.
	Chautauqua (2)	Oct. 9, 1926	327+41	182′	
	Chautauqua (3)	Also broke along	north and south levee	s in 1926	
9	Coal Creek	Not flooded			
10	Cook*	Oct. 3, 1926	201+50	128′	Not filled Aug. 3, 1927.
11	Coon Run		103+45	30′	Previous to Sept. 24, 1927.
12	Crane Creek	Not flooded			
13	Dickson*	Engineer at Cook 1 week previous	district thought it br to October 2d.	oke about	

TABLE NO. 5—Continued.

LEVEE BREAKS—1926.

No.	District.	Date of break.	Station.	Length.	Date repaired.
14	Eagle Creek*	No data			
15	East Liverpool	Oct. 5, 1926	290+30	271′	Repaired 1929.
16	East Peoria	Not flooded in 19	26; flooded from Farm	Creek in	1927.
17	Eldred	Not flooded			
18	Fairbanks	Oct. (2 or 10), 1926	529+00 North end	130′	Oct. 16, 1926.
19	Hartwell	Sept. 8, 1926	682—Northeast end—	—from H	urricane Creek.
20	Hennepin	Not flooded			
21	Hillview	Sept. 4, 1926	Southeast end		Prior to Oct. 13, 1927.
	Hillview	Sept. 8, 1926	70+00		Prior to Oct. 13, 1927.
	Hillview	Oct. 3, 1926	Southeast end		Prior to Oct. 13, 1927.
22	Indian Creek*	No data, but was	flooded		
23	Kelly Lake	Oct. 6, 1926	52+00	200′	Prior to Jan. 1, 1929.
24	Kerr (1)	Oct. 5, 1926	115+42	265′	Prior to Mar. 1, 1928.
	Kerr (2)	Sept. 15, 1926	North end by creek		
25	Kerr Crane	Sept. 15, 1926; Oct. 5, 1926	Through Kerr district		
26	Kerton Valley	Oct. 7, 1926	Levee did not break. Flooded through West Matanzas and damaged.		Damage repaired prior to Aug. 1, 1928.
27	Keystone S. & W. Co*	Not flooded			
28	Lacey-Langellier	Oct. 6, 1926		153′	Prior to Sept. 1, 1928.
	Lacey-Langellier			415′	Prior to Sept. 1, 1928.
29	Liles Metz*	Not known	8 breaks from station 3+39 to 63+00.	Total length 636′	Prior to Sept. 1, 1928.
30	Liverpool	Not flooded			
31	Lost Creek	Oct. 4, 1926	At Chandlerville Roa original levee.	d above	Prior to Sept. 1, 1928.
32	Lynchburg	Oct., 1926 (?)	25+40	90′	Not filled July 29, 1927.
	Lynchburg	Oct., 1926 (?)	83+79.5	179′	
33	Old Mauvaisterre	Not known	7 breaks between station 15+07 and 54+25.	Total length 294′	Partly filled Sept. 22, 1927.
34	Mauvaisterre	Sept. (8 or 9), 1926	South end between station 2 and station 16.		Previous to Sept. 20, 1927.
35	McGee Creek	Sept. 5, 1926	Flooded through Liles Metz and Chambersburg districts.		
	McGee Creek	Oct. 7, 1926	6+00 South	200′	Breaks repaired previous previous to Sept. 14, 1927; levee not to full grade and section.
36	Meredosia Lake	Oct. 7, 1926	258+00	63′	Previous to March, 1927. Broke again and repaired prior to Oct. 1, 1928.
37	A. J. Metz		Numerous		Prior to May 1, 1928.
38	Naples City	Sept. 8, 1926	Through Mauvaisterr	e District	
39	Nutwood	Not flooded			
40	Partridge	Abandoned			
41	Pekin and LaMarsh	Sept. 1, 1926	231+81	443′	Previous to Feb. 7, 1928.
	Pekin and LaMarsh			150′	Commissioners report.
	Pekin and LaMarsh			60′	1926.
42	Robley	Flooded around n	ortheast end of levee		
43	Rocky Ford	Not flooded			
44	Schaeffer	1926	49+60		Previous to Oct. 19, 1927.
45	Schulte	1926			
46	Scott Co	Sept. 9, 1926	Northeast end		Previous to Sept. 20, 1927.
47	Seahorn	Not flooded			
48	South Beardstown	Not flooded			
49	Spankey	Not flooded			
50	Spring Lake	Not flooded			
51	Spring Run	Not known	Opposite Coon Run station 157+75.	250′	Previous to Sept. 23, 1927.
52	Thompson Lake	Not flooded			

TABLE NO. 5—Concluded.

LEVEE BREAKS—1926-

No.	District.	Date of break.	Station.	Length.	Date repaired.
53	Tuscarora	Not flooded			
54	Valley	Not flooded			
55	Valley City	Sept. 8, 1926	9 breaks north end between station 1+15 and 16+72.	Total 793′	Prior to May 1, 1928.
56	West Matanzas	Oct. 7, 1926	180+60.5	263′	Prior to Aug. 1, 1928.
57	Wilson Ranch	Not flooded			
58	Wolf Creek	Sept. 8, 1926	13+40	45′	
59	Youngs	Not known	South end 39+00 to 60+00.	7 breaks, Total 145′	not all filled. Previous to Oct. 14, 1927.

* Several small districts, nearly all private, have been included in Table No. 5, which were not included in Tables Nos. 1 to 4.

From 1884 to 1900 the average amount of water carried by the Illinois-Michigan Canal from the Chicago River to the DesPlaines River was about 600 cubic feet per second. The Act of the Illinois Legislature providing for the construction of the Chicago Sanitary and Ship Canal required that 20,000 cubic feet per minute for each 100,000 population in the Sanitary District of Chicago should be diverted from Lake Michigan to the DesPlaines and Illinois Rivers. The Federal government, thru the War Department, issued permits from time to time for the diversion from Lake Michigan for such amounts of water as would not interfere with navigation in the Chicago River.

The increase in the stages of the Illinois River, due to diversion from Lake Michigan, may be determined by considering that the normal flow of the river is increased by the amount of the diversion from Lake Michigan, and is represented by the difference between the observed stage and the stage corresponding to a discharge rate without the diversion. The average daily flow thru the Chicago Sanitary and Ship Canal for each month since it was opened in 1900 is shown in the following Table, No. 6.

TABLE NO. 6—SANITARY DISTRICT OF CHICAGO—MAIN CHANNEL—MEAN MONTHLY AND YEARLY DISCHARGE AT LOCKPORT.

Year.	%	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.	
1900	--	1,449	2,315	2,099	2,727	3,228	3,226	3,353	3,576	2,307	3,450	3,813	4,334	2,990	Average=5,195.
1901	--	4,917	5,078	5,349	4,371	3,106	2,903	3,139	3,932	3,906	3,841	3,896	4,114	4,046	
1902	--	4,194	4,204	4,233	4,165	4,166	4,071	4,323	4,204	4,291	4,155	4,248	5,352	4,302	
1903	--	6,124	5,749	5,261	4,638	4,569	4,812	4,870	4,533	4,331	4,545	4,686	5,538	4,971	
1904	--	5,457	5,170	5,549	5,311	5,125	4,101	4,553	4,573	4,151	4,004	4,452	5,067	4,793	
1905	--	5,167	5,527	5,546	4,737	4,066	4,153	4,122	4,291	4,341	4,510	3,378	3,919	4,480	
1906	--	4,457	4,626	4,393	4,568	4,719	4,420	3,996	3,426	3,740	5,221	5,198	4,907	4,473	
1907	--	5,304	5,467	4,954	4,959	5,032	5,522	5,597	6,249	4,703	4,205	4,395	5,005	5,116	
1908	4	4,057	4,462	6,781	7,660	7,529	7,466	6,861	6,704	6,533	6,506	6,371	6,389	6,443	
1909	5	6,154	6,117	6,090	6,704	6,813	6,886	7,133	7,014	6,587	6,197	6,072	6,178	6,495	
1910	6	6,830	6,459	7,055	6,964	6,968	7,219	6,870	6,677	6,572	7,061	6,800	6,523	6,833	
1911	7	6,128	6,113	5,943	6,072	6,246	7,154	7,646	7,354	7,578	7,902	7,611	7,001	6,896	Average=7,992.
1912	8	6,239	5,968	6,135	6,829	6,344	6,871	7,500	7,766	7,764	7,619	7,411	6,809	6,939	
1913	9	6,822	6,629	6,487	6,768	7,874	8,372	8,567	9,156	9,151	8,662	7,957	7,635	7,839	
1914	10	7,319	7,312	6,858	7,205	8,027	8,168	7,863	8,252	9,060	8,392	7,624	7,703	7,815	
1915	11	7,451	7,661	7,344	6,809	7,587	7,875	7,772	8,470	8,085	7,748	7,986	8,064	7,738	
1916	12	7,926	7,601	7,572	7,491	7,759	8,506	9,569	9,065	8,163	7,972	8,434	8,345	8,200	
1917	12	8,147	7,850	7,746	7,883	8,109	9,190	9,976	9,876	9,703	9,107	8,758	8,361	8,726	
1918	13	7,721	8,492	8,354	8,604	8,962	9,486	9,928	9,348	8,668	8,722	8,726	8,910	8,826	
1919	13	8,537	8,023	8,563	8,780	9,754	9,006	8,586	8,486	8,225	8,615	8,675	7,882	8,595	
1920	14	8,178	8,114	8,528	8,246	7,776	8,046	8,219	8,502	9,061	8,753	8,472	8,258	8,346	
1921	14	7,818	7,795	7,798	8,051	7,771	8,132	8,924	8,581	8,596	8,876	9,121	8,757	8,355	Average=8,577.
1922	15	8,418	8,328	9,014	8,563	9,226	9,321	9,431	8,968	9,137	8,822	8,808	8,228	8,858	
1923	15	8,126	7,761	8,011	7,953	8,328	8,448	8,402	8,756	8,749	8,677	8,545	8,374	8,348	
1924	15	7,708	8,369	9,829	10,050	9,929	10,820	10,073	10,598	9,786	9,462	8,717	8,208	9,465	
1925	15	7,737	8,003	8,348	8,641	8,608	8,763	8,768	8,493	8,612	8,281	7,526	7,547	8,278	
1926	12	7,189	7,744	7,960	8,846	8,605	9,145	8,871	8,955	7,828	6,745	8,815	8,690	8,283	
1927	12	8,520	7,870	9,110	7,855	6,790	6,555	7,835	9,115	10,045	9,795	10,245	7,675	8,450	
1928	12	8,455	------	------	------	------	------	------	------	------	------	------	------	------	
1929	--	------	------	------	------	------	------	------	------	------	------	------	------	------	
1930	--	------	------	------	------	------	------	------	------	------	------	------	------	------	

1908 to 1925 inclusive—discharge=(turbine flow from rating tables 1912+615CFS+dams and sluice gates flow) 1.00+ per cent.

1926 to date. Percentage added only to turbine flow.

NOTE.—All discharges are expressed in cubic feet per second. The diversion authorized by Federal Permit of March 5, 1925 is an annual average of 8,500 cubic feet per second plus the City of Chicago pumpage, which averages approximately 1,500 cubic feet per second, giving an authorized discharge of 10,000 cubic feet per second. Since the issuance of the permit the discharge has been under the control of the U. S. District Engineer. By his order, at times of flood in the Illinois and Mississippi Rivers, the flow has been reduced below the permit authorization.

EFFECT OF LEVEES ON FLOOD STAGES.

The practical effect of building levees on the Illinois River has been to increase the stages and prolong the duration of high water. The fall or slope has been so modified from LaSalle to Hardin that during the critical period, when the flood wave is passing, the carrying capacity of the river channel at any stage is less than before the levees were built and even at the maximum stages which have been attained since levees were constructed, the carrying capacity of the channel is less than the carrying capacity at maximum stages before the levees were built. The changes in the flood-plain produced by construction of levees, and the increased flood stages between LaSalle and Grafton compared with 1904 are shown in the following Table No. 7.

TABLE NO. 7—FLOOD-PLAIN AREAS AND INCREASE IN FLOOD STORAGE, 1904 TO 1926

Location.	Area of flood-plain.		Average increase flood stage.	Storage Acre-feet		Increase or decrease in storage 1904 to 1926, acre-feet.
	1904	1926		1904.	1926.	
LaSalle to Peoria	59,430	57,120	0.78 ft.	828,400	832,000	+3,600
Peoria to Havana	55,700	20,500	2.75 ft.	587,000	280,000	—307,000
Havana to Beardstown	60,600	54,580	4.98 ft.	582,800	635,000	+52,000
Beardstown to Valley City	67,000	11,670	5.59 ft.	589,800	194,400	—394,900
Valley City to Pearl	40,400	5,860	3.68 ft.	296,000	74,600	—221,000

LITIGATION.

The State of Wisconsin some years ago brought suit in the United States Court to enjoin the Sanitary District of Chicago and the State of Illinois from diverting water from Lake Michigan. Other states bordering the Great Lakes joined in the suit. A decision was recently handed down by the Supreme Court of the United States finding that the Sanitary District of Chicago has no right to divert water for sanitary purposes, but that the United States Government has the right to use water necessary for navigation. A determination of the time and conditions under which the decision can be enforced is now pending under orders of the United States Supreme Court.

An Act under which the Sanitary District of Chicago was created provides that the owners of land that may be overflowed by the increased stages of the river, produced by the diversion of water from Lake Michigan, may recover damages from the Sanitary District of Chicago. Owners of land in the Illinois Valley have been negotiating and litigating with the Sanitary District of Chicago to recover damages for overflow during almost the entire period since the flow began, and there are now pending before the courts and before the Special Commission, authorized by the Fifty-fifth General Assembly of Illinois, claims in excess of $10,000,000. Prosecution and defense of these claims have created among the people thruout the valley intense feeling and suspicion against the Sanitary District of Chicago, which is a drawback to the development of the valley. Notwithstanding that the Deep Waterway from the Lakes to the Gulf requires a diversion of water to maintain navigation, the people who own the lands are less interested in deep waterways than they are in the preservation of their property, and many oppose the Deep Waterway Project because of their feeling against the Sanitary District of Chicago.

INVESTMENT VALUES.

The importance as a community value of the land in the levee districts of the Illinois Valley is indicated by the summation from the Tables of Statistical Data. These statistics were obtained, in part, from the records at the county seats of the counties in which the districts are located, and from owners and district officers. From the summation of Statistical Data, Table No. 8, it will be observed that the organized levee districts cover 201,194 acres, more than one-half of the valley area. There remain 71,000 acres available for leveeing. It will also be ob-

served that there are 4,295 persons residing in the districts and 1,810 persons employed in, but residing outside the district. It will also be observed that the average value of the land is $105.00 per acre, with a total valuation of $22,176,000.00. The Alvord and Burdick report showed $112.00 per acre as the average value of the leveed land in 1914. It will also be noted that the average cost of reclaiming the land has been $63.50 per acre, and the present outstanding bonded indebtedness is an average of $26.50 per acre.* The estimated market value of the farm crops on these leveed lands is over $6,500,000.00, or an average of about $35.00 per acre, estimating 80 per cent of the cultivated area in corn, 15 per cent in wheat and 5 per cent in oats, using as average market prices per bushel, 75 cents for corn, $1.00 for wheat and 40 cents for oats. The estimated market value of the crops produced is slightly more than $1,000 per capita, resident and non-resident, employed on this land.

TABLE NO. 8.—SUMMATION STATISTICAL DATA—LEVEE DISTRICTS IN ILLINOIS RIVER VALLEY.

Total area in Districts	201,194	acres
Assessable	188,873	acres
Cultivated	183,519	acres
Levees	332	miles
Open ditches	376	miles
Tile ditches-mains	267	miles
Highways graded	241	miles
Highways graveled	1.5	miles
Highways paved	19.85	miles
Railroads	41	miles
Dwellings	1,043	
Resident population	4,295	persons
Non-resident employed	1,810	persons
Corn produced per acre	52	bu. average
Wheat produced per acre	52	bu. average
Oats produced per acre	40	bu. average
Hay produced per acre	2	tons average
Value of land per acre	$ 105.00	average
Total farm improvement	2,500,000.00	
Farm improvements	12.00	per acre average
Total farm values	22,176,000.00	
Damages to farm improvements 1926-27 floods	336,330.00	
Cost repairs to levees and ditches since 1922 flood	3,095,000.00	
Assessments total	11,809,000.00	
Assessments paid cash	3,098,000.00	
Bonds issued	9,044,000.00	
Bonds outstanding	4,977,000.00	
Cost per acre (average)	63.50	
Bonds per acre (average) issued	49.50	
Bonds per acre (maximum) issued	168.00	
Bonds per acre (outstanding)	26.50	

NOTE.—All statistics were obtained from statements of land owners and officers of levee districts and are approximately correct.

RAINFALL AND RIVER STAGES.

Any discussion or study of floods, without taking into consideration the rainfall, would seem to be inadequate and inconclusive. The daily rainfall records published by the U. S. Weather Bureau, for rainfall stations maintained on or adjacent to the watershed of the Illinois River, are the sources of information for this report. There are many varying

* Note by the Division of Waterways.
It should be noted that an average of $14.00 per acre has been paid by owners in cash and represents in most cases an unpaid mortgage on their property so that the actual unpaid cost of reclaiming the land is probably nearer $36.00 per acre. Also it might be mentioned that much of the land in these Drainage and Levee Districts has had to be mortgaged to pay interest and to carry on farming operations largely because of crop losses during flood years.

elements of climate, season, soil and topography which affect the ratio of rainfall reaching the streams as flood run-off. These variables cannot be definitely allocated and can only be taken into account upon the laws of experience and averages. The rainfall records from the Illinois River watershed cover a period of 71 years, from 1856 to 1927.

The rainfall of any storm varies greatly at different points. Frequently there are local showers that cover only relatively small areas, so that the rainfall record of any one station is not representative of the entire area of the watershed. Rain gauging stations are not equally distributed over the watershed and the arithmetical average of the daily rainfall does not give the correct volume of rainfall. To obtain the nearest practicable volume of rainfall a "weighted average" was obtained. The daily recorded rainfall at each gauging station was multiplied by a factor representing the ratio of the area assigned to each gauge to the area of the watershed. The area of each gauge was determined by extending half way to the next gauge station. A hydrograph of river stages was platted for each tributary and for a number of points along the Illinois River, together with the weighted average rainfall to graphically show the relation between rainfall and the river stages. See Figures A 10 to A 36 Appendix A.

Detailed studies of the amount of rainfall and the amount of rise, due to that rainfall, are discussed and shown in Tables A 1-A 10 Appendix A. The number of flood crests studied and the maximum, mimimum and average rise per inch of rainfall are shown in the following Table No. 9.

TABLE NO. 9—RISES IN FEET PRODUCED BY ONE INCH OF RAINFALL.

Station.	Season.	Floods of 1892, 1893, 1898, 1900, and 1904.				Floods of 1913, 1915-16, 1922, and 1926-27.			
		Number of rises.	Rise in feet per inch of rainfall.			Number of rises.	Rise in feet per inch of rainfall.		
			Maximum.	Mean.	Minimum.		Maximum.	Mean.	Minimum.
Morris	Dec.-Apr	23	9.34	4.12	1.19	20	5.92	3.65	2.35
	May-Nov	2	1.92	1.47	1.01	10	4.25	2.50	1.27
LaSalle	Dec.-Apr	7	5.33	4.22	1.06	27	9.56	3.22	0.83
	May-Nov	4	2.83	1.90	0.60	8	3.61	2.24	1.65
Peoria	Dec.-Apr	22	5.09	2.51	0.95	18	4.58	2.30	0.40
	May-Nov	8	3.48	1.59	0.48	13	2.96	1.59	0.48
Havana	Dec.-Apr	13	3.86	2.15	0.59	10	3.46	1.85	0.99
	May-Nov	1	1.14	1.14	1.14	15	4.28	1.45	0.32
Beardstown	Dec.-Apr	14	4.62	2.09	0.72	11	3.61	1.93	0.68
	May-Nov	10	3.95	1.12	0.33	15	4.00	1.74	0.42

STORM CENTERS AND RAINFALL.

The storms which have produced the great floods on the Illinois River approach from the southwest. The rainfall on the Sangamon and other southern tributaries is frequently 50 to 100 per cent more than on the northern area.

Studies of storm travel and frequency by the Miami Conservancy District after the great storms of 1913 showed that the centers of greatest rainfall pass to the south of the Illinois River watershed with diminishing rainfall on each side. Occasional storms with heavy rainfall approach from the west, but these do not cover so large an area nor produce as much rainfall as those approaching from the southwest. The air from over the warm waters of the Gulf of Mexico, heavily ladened with moisture, flowing northeast and meeting the colder air currents from the north, produce the great rainstorms which traverse the Central Mississippi Valley and the Illinois watershed is in the path of the northern margin of many of these storms. From all available data it seems improbable that any of the greater storms will center over the Illinois River watershed and therefore that the rainfall of September, 1926, which produced the maximum stages on the Illinois will seldom if ever be exceeded. The rainfall in the first half of 1927 was also unprecedented in the records of the Illinois Valley and produced floods almost equal to that of 1926.

The total rainfall at Peoria, June to November inclusive, 1926, was 37.94 inches; the normal of these months is 19.38 inches with an excess of 18.56 inches or nearly 100 per cent. The total rainfall February to July inclusive, 1927, was 32.14 inches; the normal is 19.43 inches with an excess of 12.71 inches or nearly 70 per cent. The last half of 1926 and first half of 1927 is the period of greatest rainfall and prolonged floods in the history of Illinois. It will be interesting to note here in detail the normal monthly rainfall for the Illinois watershed and that which occurred at Peoria in the last half of 1926 and first half of 1927, shown in Table No. 10 and No. 11.

TABLE NO. 10—NORMAL MONTHLY RAINFALL, ILLINOIS RIVER WATERSHED.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
North of latitude of Peoria	1.74	1.59	2.60	2.88	3.89	3.75	3.30	3.28	3.69	2.43	1.97	1.71
South of latitude of Peoria	2.14	1.89	3.16	3.46	4.07	3.94	3.34	3.40	3.65	2.48	2.34	2.15
Combined	1.94	1.74	2.88	3.18	3.98	3.84	3.32	3.34	3.67	2.45	1.93	2.16

TABLE NO. 11.—RAINFALL AT PEORIA FLOOD PERIOD 1926 AND 1927.

1926. Month.	Precipitation.	1927. Month.	Precipitation.
June	5.63	February	2.85
July	5.94	March	4.55
August	6.79	April	4.87
September	11.55	May	9.22
October	2.62	June	5.71
November	5.41	July	4.94
Totals	37.94	Totals	32.14
Normal	19.38	Normal	19.43
Excess	18.56	Excess	12.71
An. Normal	34.97	An. Normal	34.97

RAINFALL MAPS.

Rainfall maps herewith, Figure No. 7, to Figure No. 16, inclusive, show the distribution of rainfall over the Illinois watershed that produced the ten (10) floodcrests which have been especially studied, viz.,

April	1927	October	1926
April	1922	January	1916
April	1913	April	1904
March	1900	March	1898
March	1893	May	1892

The major floodcrests on the lower river occurred in 1904, 1922, 1926 and 1927. Each of these floods was the result of a succession of storms covering periods of from two weeks to 35 days, and the accumulated rainfall is shown by the isohyetal lines, or lines of equal rainfall. Each of these rainfall maps, except 1892, show the greater depth of rainfall on the southern portion of the watershed. The range in rainfall for the various years was as follows:

1. 1927—From 14″ at the south to 6″ at the north end of the watershed.
2. 1926—21″ at Decatur and Beardstown in the southern and western portions and 7″ in the northeast portion of the watershed.
3. 1922—17″ in the southern portion and 4″ in the northern portion of the watershed.
4. 1904—8″ in the southern portion and 5″ in the northern portion of the watershed.
5. 1916—9″ in the southern portion and 4″ in the northern portion of the watershed.
6. 1913—7″ in the southern portion and 2″ in the northern portion of the watershed.
7. 1900—5″ in the southern portion and 2″ in the northern portion of the watershed.
8. 1898—9″ in the vicinity of Decatur, southern portion, and 4″ in the northern portion of the watershed.
9. 1892—The storm was of a different character with a maximum rainfall of 9″ in the vicinity of Ottawa, 3″ to 4″ in the southern portion and 3″ in the northern portion of the watershed.

The flood stages generally progress normally down-stream from Morris to Beardstown, and from Beardstown to the mouth the crests are frequently in advance of the Beardstown crest, due to the in-flow of the tributaries and the earlier cresting of the Mississippi at Grafton.

RAINFALL FREQUENCY AS RELATED TO FLOODS ON ILLINOIS.

All great floods result from a succession of rainfall periods, which occur at intervals of usually about seven days with heavy precipitation for one to three days in each period. Spring and late winter rains produce greater flood stages relative to rainfall than summer rains, but the distribution duration and intensity of the rain storms are the controling factors in flood run-off. Since a succession of rain periods covering from two weeks to five weeks is necessary to produce a great flood, studies were made of the monthly and bimonthly rate of rainfall to be expected. These studies indicated that the distribution and intensity

are of equal or greater importance than the total rainfall and the results were not useful.

SECTION II—HYDRAULICS.

INTRODUCTORY.

A thorough investigation of the hydraulics of the river was necessary for the study and solution of the problem involved in this report. Much of the basic data obtained in years past has become obsolete because of the altered physical characteristics of the valley.

The water now has a narrow passage through which to flow, consequently any volume will rise to higher levels in the efforts to get away. The storage conditions are modified and the retarding effects are changed. Where formerly a large part of the flow was through timbered areas, much of that portion is now diverted to the channel proper. This has the effect of changing the friction co-efficients which had to be redetermined.

Considerable new data was furnished by observation on the floods of recent years by the U. S. Engineers, U. S. Geological Survey and the Sanitary District of Chicago, which increased the opportunity for hydraulic research. Although the conditions under which the measurement of flow must be made in flood periods cause apparent inconsistencies in the results, there has been accumulated such a quantity of material that by comparing and averaging measurements, deductions can be made, conclusions drawn from studies and forecasts made as to the probable future flood heights to be attained with a greater degree of certainty than has been heretofore possible.

U. S. ENGINEERS SURVEYS OF 1902-1905.

The surveys of the valley by the U. S. Engineer Department from 1902 to 1905 (House Document 263, Fifty-ninth Congress, First Session) was thorough and made in such detail that it has supplied much of the basic data for hydraulic investigations. A major portion of the territory surveyed between LaSalle and Grafton and over the width of the valley has changed more in appearance than in contour. By the construction of levees land has been reclaimed, swamps and timbered areas have been converted into cultivated fields, but the cross section of the valley for practical purposes has been altered only by the filling in or scouring of the river bed, which is a very small portion of the valley section.

Surveys have been made within the past few months by the U. S. Engineers to determine the change in regimen of the river channel, but soundings were not reduced until recently so that only a part of the data obtained was available for use in this report. The changes that have taken place are known to be so small that flood flow areas here used are not materially affected.

VALLEY SECTIONS AND STORAGE AREAS.

Cross-sections of the Illinois River Valley between Starved Rock and Grafton were platted from the topography sheets of the U. S. Engineers 14-foot Waterway Survey at 149 places, at intervals of from

1,900 to 20,200 feet, and combined into 49 "reaches," ranging in length from 5,000 to 40,000 feet. The levees were located on these maps by the Engineers of the Sanitary District of Chicago. The locations for the cross-sections were chosen and combined into reaches (see Table No. B 1 Appendix B) without great variation in cross-section, as controlled by levees on one side of the channel or on both sides of the channel, etc. The areas of the overflow sections, exclusive of the channel, were determined from the platted cross-sections (see Figure No. 17). The areas of the channel section for each reach were determined by adding to the average area below the 1901 low water for each reach, the area above the low water for the reach, determined by multiplying the average width of the channel by the depth above the elevation of the 1901 low water. The area of the channel section was determined from cross-sections and tabulated areas at intervals of about 200 to 500 feet, furnished by the U. S. Engineer's Office at Peoria.

Table No. B 2, Appendix B shows:

1. The station in miles and in 1,000 feet above Grafton of the beginning and end of each reach.
2. The elevation of the 1901 low water at the centers of reaches.
3. The average width of the channel through the reach at the elevation of the 1901 low water.
4. The average area of the channel through the reach below the elevation of the 1901 low water.
5. The length of the reach in feet.
6. The width of the over-bank section, exclusive of the channel, for each foot of depth above bank-full stage.
7. The area of the over-bank section, exclusive of the channel, for each foot of depth above bank-full stage.
8. The areas of the channel for each foot depth above bank-full to high water, including area below bank-full stage.
9. The combined area of the over-banks and channel sections for each foot of depth above bank-full to high water.

Storage in the Illinois River Valley above bank-full stage was prepared by adding the cross-section areas of the over-banks section, shown in Table No. B 2, in Appendix B, the channel storage above the low water stage and reducing to acre-feet.

Table of Storage, No. B 3, Appendix B, shows:

1. The station numbers (1,000-foot stations) above Grafton for the beginning and end of each reach.
2. The length of each reach in feet.
3. The increase in storage for each foot in elevation from bank-full stage to high water for the elevation of the center of the reach.
4. Total storage for each foot of elevation at the center of the reach above bank-full stage.

Figure No. 17 indicates the method of combining the end areas to obtain river floodway storage. Storage is also shown on diagrams, Figure No. B 1 to Figure No. B 10, Appendix B.

Figure No. 18 is a diagram for scaling the storage above the bottom land in five reaches, from lower end of Nutwood Levee District to LaSalle.

STAGE RECORDS.

In the Alvord and Burdick "Report on the Illinois River and its Bottom Lands" there is published a list of gages in the Illinois and Des-Plaines Rivers up to 1914. Most of these gages are still maintained, but others have been installed in recent years and the elevations of many have been changed.

Table No. 12 is a list of the present gages of the Illinois River and tributaries, as compiled by the engineers of the Sanitary District of Chicago, giving the stations, authorities and elevations of gages where readings were taken along the river between LaSalle and Grafton, and used in the studies of this report.

TABLE NO. 12—STATIONS AND ELEVATIONS OF GAGES, ILLINOIS RIVER.

Station.	Miles above Grafton.	Sanitary District of Chicago.	U. S. Engineers.	U. S. G. S.	U. S. Weather Bureau.	(1928) Elevation of zero, Memphis datum.
0					Grafton	410.99
165+792	31.4		Kampsville (lower)			409.10
166+320	31.5		Kampsville (upper)			409.13
227+750	43.2		Pearl			419.70
325+250	61.6		Valley City			421.75
375+250	71.1		Meredosia			424.22
409+200	77.5		LaGrange (lower)			418.23
409+750	77.6		LaGrange (upper)			418.23
469+100	88.8		Beardstown (C. B. & Q. R. R. bridge)		Beardstown Highway bridge	427.25
512+500	97.2	Browning				433.35
589+776	111.7	Bath				433.46
633+300	119.9		Havana			431.93
676+000	128.0	Liverpool				440.30
721+776	136.7		Copperas Creek (lower)			427.75
722+300	136.8		Copperas Creek (upper)			432.73
766+765	145.6	Kingston Mines				439.73
807+350	152.9		Pekin			438.57
847+968	160.6		Peoria (P.&P.U. bridge)			
856+750	162.3				Peoria (lower wagon bridge)	435.82
866+448	164.1		Peoria (U. S. boat yard)			
960+300	181.9	Chillicothe				436.32
998+700	189.1	Lacon				442.99
1,034+880	196.0		Henry (lower)			436.64
1,035+408	196.1		Henry (upper)			443.79
1,095+072	207.6	Hennepin				442.60
1,185+600	224.5	LaSalle Highway				444.13

High water stages of the Illinois River between Grafton and La-Salle are recorded in House Document 263, Fifty-ninth Congress, First Session, pages 193 to 206, with description of the high water marks and the authorities for the information. The following Table, No. 13, gives the revised high water data from 1879 to 1927, inclusive, for the Illinois River from Grafton to Morris. This data is taken from House Document 263, Fifty-ninth Congress, First Session, for the period from 1879 to 1904, inclusive, and subsequently from the gage records of the U. S. Weather Bureau, U. S. Engineers and the Sanitary District of Chicago.

TABLE NO. 13—ANNUAL HIGH WATER DATA AND ELEVATION—ILLINOIS RIVER.

	1927		1926		1925		1924		1923		1922		1921	
	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1. Grafton	Apr. 26	436.69	Oct. 6	434.69	June 25 Mar. 29	423.79 420.19	July 3	429.59	Jan. 14 Mar. 30	425.19 422.39	Apr. 20	436.79	Apr. 29	426.59
2. Hardin														
3. Kampsville, below lock	Apr. 26	440.65	Oct. 6	439.90	Mar. 29	428.50	July 4	433.70	Mar. 20	428.75	Apr. 19	441.15	Apr. 29	430.40
4. Kampsville, above lock	Apr. 26	440.73	Oct. 6	440.03	Mar. 29	428.73	July 4	433.83	Mar. 25	429.08	Apr. 19	441.28	Apr. 29	430.58
5. Pearl	Apr. 26	442.40	Oct. 6	441.70	Mar. 29	431.50	July 5	435.90	Mar. 30	431.50	Apr. 19	442.70	May 5	432.20
6. Valley City	Apr. 27	447.52	Oct. 22	447.50							Apr. 19	447.40		
7. Meredosia	Apr. 27	448.87	Oct. 12	449.29							Apr. 19	448.55		
8. LaGrange, below lock	Apr. 27	449.33	Oct. 12	450.28	Mar. 29	440.08	July 5	443.73	Mar. 28	440.03	Apr. 19	449.38	May 5	439.53
9. LaGrange, above lock	Apr. 27	449.38	Oct. 12	450.33	Mar. 29	440.58	July 5	443.93	Mar. 28	440.58	Apr. 19	449.43	May 5	440.03
10. Beardstown	Apr. 27	452.45	Oct. 12	453.61	Mar. 29	442.70	July 4	446.90	Mar. 28	442.65	Apr. 20	452.45	May 5	441.89
11. Browning	Apr. 26	453.05	Oct. 12	454.15										
12. Sharps Landing														
13. Bath	Apr. 26	453.26	Oct. 12	454.36	Mar. 28	444.26	July 4 Aug. 27	447.86 448.06	Mar. 27	444.46	Apr. 19	453.09	May 5 Dec. 10	443.76 443.96
14. Havana	Apr. 26	453.93	Oct. 12	455.03	Mar. 28	445.93	Aug. 25	450.63	Mar. 27	446.23	Apr. 20	454.33	Dec. 11	445.93
15. Liverpool	Apr. 25	454.70	Oct. 12	456.10	Mar. 28	446.90	Aug. 25	452.30	Mar. 27	447.30	Apr. 19	454.90	Dec. 8	447.30
16. Copperas Creek, below lock														
17. Copperas Creek, above lock	Apr. 25	455.08	Oct. 12	456.68	Mar. 27	447.98	Aug. 25	453.08	Mar. 27	448.38	Apr. 17	455.33	Dec. 8	448.38
18. Kingston Mines	Apr. 24	457.15	Oct. 9	457.73	Mar. 27	449.03	Aug. 24	454.33	Mar. 27	449.43	Apr. 17	457.23	Dec. 6 Dec. 23	449.56 449.63
19. Pekin	Apr. 23	458.67	Oct. 9	459.37	Mar. 27	450.17	Aug. 24	455.47	Mar. 26	450.92	Apr. 17	459.17	Dec. 23	451.12
20. Peoria, lower bridge	Apr. 23	460.22	Oct. 9	460.82	Mar. 26	452.22	Aug. 24	456.72	Mar. 28	453.02	Apr. 16	460.52	Dec. 24	453.42
21. Peoria, upper bridge														
22. Chillicothe	Apr. 24	460.77	Oct. 9	461.32	Mar. 26	452.77	Aug. 24	457.12	Mar. 26	453.62	Apr. 16	461.12	Dec. 22	453.72
23. Lacon	Apr. 24	460.99	Oct. 9	461.49	Mar. 26	452.89	Aug. 24	457.04	Mar. 25	453.59	Apr. 15	461.24	Dec. 22	453.79
24. Henry, below lock	Apr. 23	461.44	Oct. 8	461.84	Mar. 26	453.24	Aug. 24	457.54	Mar. 25	454.14	Apr. 15	461.79	Dec. 22	454.14
25. Henry, above lock	Apr. 23	461.69	Oct. 8	461.99	Mar. 26	453.39	Aug. 23	457.49	Mar. 25	454.19	Apr. 15	461.87	Dec. 21	454.29
26 Hennepin	Apr. 23	461.70	Oct. 8	462.15	Mar 24	453.80	Aug. 23	457.60	Mar. 25	454.55	Apr. 15	461.95	Dec. 20	454.65
27. Depue	Apr. 22	462.15	Oct. 8	462.55	Mar. 24	454.25	Aug. 23 Apr. 4	457.95 458.05	Mar. 24	455.05	Apr. 14	462.45	Dec. 20	455.35
28. Peru	Apr. 22	462.80	Oct. 7	463.10	Mar. 23	455.30	Apr. 3 Aug. 11	459.20 459.50	Mar. 18	456.00	Apr. 13	463.50	Dec. 19	456.30
29. LaSalle Lock 15														
30. LaSalle Wagon Bridge	Apr. 21	464.33	Oct. 7	464.13	Mar. 22	456.33	Aug. 11	460.53	Mar. 18	457.23	Apr. 12	464.43	Dec. 19	457.53
31. Morris	Apr. 19 Feb. 6	505.36 505.66	Oct. 5 Apr. 11	502.16 502.36	Mar. 21	497.61	Aug. 10	504.26	Mar. 17	498.76	Apr. 12	506.16	Dec. 18	498.26

TABLE NO. 13—Continued.

	1920		1919		1918		1917		1916		1915		1914	
	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1. Grafton	Apr. 25	433.39	May 11 Mar. 29	432.39 429.19	June 17 Mar. 5	428.39 421.59	June 14	433.89	Feb. 1	434.39	June 24 Aug. 23	431.29 429.89	June 27 Apr. 18	423.59 419.29
2. Hardin														
3. Kampsville, below lock	Apr. 26	437.05												
4. Kampsville, above lock	Apr. 26	437.23												
5. Pearl	Apr. 27	438.80	Mar. 29	436.30	Mar. 5 Feb. 26	431.50 431.40	June 15	437.86	Feb. 2	439.60	Aug. 23	434.95	Apr. 18	429.87
6. Valley City									Feb. 2	444.70	Aug. 23	437.70		
7. Meredosia									Feb. 1	446.17	Aug. 24	438.87		
8. LaGrange, below lock	Apr. 30	445.68												
9. LaGrange, above lock	Apr. 30	445.83												
10. Beardstown	Apr. 28	448.55	Mar. 28	446.75	Feb. 27	442.95	June 17	446.35	Feb. 1	447.95	Aug. 23 Aug. 31 Aug. 10	441.95 442.03 441.65	Apr. 16	440.65
11. Browning														
12. Sharps Landing														
13. Chandlerville														
14. Bath	Apr. 27	449.83												
15. Havana	Apr. 26	451.33	Mar. 27	450.23	Feb. 26	447.13	June 17	448.93	Jan. 31	451.43	Aug. 10	446.53	Apr. 15	444.73
16. Liverpool	Apr. 27	451.90												
17. Copperas Creek, below dam														
18. Copperas Creek, above dam	Apr. 27	452.53												
19. Kingston Mines	Apr. 26	455.05												
20. Pekin	Apr. 25	456.62												
21. Peoria, lower bridge	Apr. 25	458.66	Mar. 22	458.96	Feb. 20	455.46	June 16	453.96	Jan. 25	458.86	Aug. 8	454.26	Apr. 12	451.22
22. Peoria, upper bridge														
23. Chillicothe	Apr. 25	459.22												
24. Lacon	Apr. 25	459.34												
25. Henry, below lock	Apr. 24	459.74	Mar. 22	460.45	Feb. 18	457.45	June 16	455.22						
26. Henry, above lock	Apr. 24	459.99												
27. Hennepin	Apr. 24	460.47												
28. Depue	Apr. 24	460.87												
29. Peru	Apr. 23	461.70	Mar. 19	462.80	Feb. 16	461.50	June 15	456.50						
30. LaSalle, Lock 15														
31. LaSalle, wagon bridge	Apr. 23	462.93	Mar. 19	464.33	Feb. 16	463.13	June 15	458.03	Jan. 22	467.63	Aug. 15	460.13	Apr. 3	455.83
32. Morris	Apr. 21	503.86	Mar. 18	506.26	Feb. 16	503.66	June 10	499.01	Jan. 21	509.76	Aug. 4	503.14	Apr. 3 May 13	497.44 498.44

TABLE NO. 13—Continued.

	1913		1912		1911		1910		1909		1908		1907	
	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1. Grafton	Apr. 11	431.49	Apr. 10	434.49	Oct. 4	426.29	May 10 Jan. 27	425.29 419.59	July 15 May 12	433.59 430.49	June 18 May 27	434.69 429.09	Jan. 23	429.09
2. Hardin														
3. Kampsville, below lock	Apr. 11	438.25												
4. Kampsville, above lock	Apr. 11	438.43												
5. Pearl	Apr. 11	440.65	Apr. 10	439.35	Oct. 7	434.71	Jan. 27	432.60	May 12	435.30	May 26	539.50	Jan. 23 Feb. 3 Jan. 31	433.70 435.80 435.60
6. Valley City														
7. Meredosia	Apr. 10	447.17												
8. LaGrange, below lock	Apr. 10	447.98												
9. LaGrange, above lock	Apr. 10	448.08												
10. Beardstown	Apr. 5	449.05	Apr. 4	446.05	Oct. 7	444.15	Jan. 31 Mar. 15	441.40 440.95	May 10	442.75	May 24	447.85	Jan. 30	445.55
11. Browning	Apr. 4	450.05												
12. Sharps Landing														
13. Chandlerville														
14. Bath	Apr. 4	450.43												
15. Havana	Apr. 4	451.57	Apr. 4	448.83	Oct. 7	446.33	Mar. 15	446.03	May 8	446.83	May 23 July 17 Mar. 14	451.63 451.83 450.53	Jan. 27	449.25
16. Liverpool	Apr. 4	452.38												
17. Copperas Creek, below lock	Apr. 4	453.05												
18. Copperas Creek, above lock	Apr. 4	453.23												
19. Kingston Mines	Apr. 4	454.34												
20. Pekin	Apr. 2	455.80												
21. Peoria, lower bridge	Apr. 2	458.12	Apr. 1	455.62	Oct. 7 Nov. 24	451.12 451.63	Mar. 12	453.12	May 5	453.62	Mar. 10	458.02	Jan. 25	456.22
22. Peoria, upper bridge														
23. Chillicothe	Apr. 1	458.82												
24. Lacon	Mar. 30	459.52												
25. Henry, below lock	Mar. 30	459.34												
26. Henry, above lock	Mar. 30	460.39												
27. Hennepin														
28. Depue														
29. Peru														
30. LaSalle, Lock 15														
31. LaSalle, wagon bridge	Mar. 29	463.43	Mar. 28	460.13	Nov. 19	455.93	Mar. 8 Jan. 30	458.33 458.33	May 2 Apr. 23	458.53 458.03	Mar. 7	464.36	Jan. 27	466.00
32. Morris	Mar. 28	504.79	Mar. 27	500.54			Jan. 20	499.94	Apr. 23		Mar. 7	508.01	Jan. 19	501.83

TABLE NO. 13—Continued.

		1906		1905		1904		1903		1902		1901		1900	
		Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1.	Grafton	Apr. 15	429.19	June 16	429.19	Apr. 30	435.06	June 11	439.96	July 26 July 28	431.36 430.76	Apr. 11	427.56	Mar. 16 Mar. 23	428.15 425.45
2.	Hardin														
3.	Kampsville, below lock					May 1	437.08	June 12	440.30	July 28	435.05	Apr. 11	431.62	Mar. 23	433.35
4.	Kampsville, above lock					May 1 Apr. 6	437.14 436.99	June 12	440.33	July 28	435.23	Apr. 10	431.96	Mar. 23	433.63
5.	Pearl	Apr. 13	434.90	June 17	432.70	Apr. 6	439.03	June 12	440.35	July 28	437.05	Apr. 10	433.70	Mar. 22	435.80
6.	Valley City					Apr. 6	442.75	June 12	440.75	July 28	440.75	Apr. 8	437.83	Mar. 21	440.30
7.	Meredosia					Apr. 6	444.67	June 12 Mar. 21	440.87 442.01	July 28	442.59	Apr. 8	439.87	Mar. 21	442.32
8.	LaGrange, below lock					Apr. 6	445.38	Mar. 21	442.68	July 27	443.33	Apr. 7	440.63	Mar. 20	443.08
9.	LaGrange, above lock					Apr. 6	445.48	Mar. 21	442.78	July 27	443.53	Apr. 7	440.93	Mar. 20	443.28
10.	Beardstown	Apr. 11	442.85	June 15	441.35	Apr. 4	447.25	Mar. 21	444.23	July 26	445.25	Apr. 6	442.45	Mar. 19	444.95
11.	Browning														
12.	Sharps Landing														
13.	Chandlerville														
14.	Bath														
15.	Havana					Apr. 2	451.57	Mar. 15	448.77	July 24	450.92	Apr. 4	446.97	Mar. 18	449.07
16.	Liverpool														
17.	Copperas Creek, below lock														
18.	Copperas Creek, above lock					Apr. 1	453.23	Mar. 14	450.33	July 25 July 24 July 23	Over gage 452.23 Over gage	Apr. 3	448.53	Mar. 18	450.73
19.	Kingston Mines					Apr. 1	453.94								
20.	Pekin					Mar. 28	455.22	Mar. 13	452.32	July 23	453.97	Apr. 1	450.47	Mar. 17	452.97
21.	Peoria, lower bridge	Mar. 10	451.72	May 18	453.72	Mar. 28	458.82	Mar. 12	455.12	July 22	456.82	Mar. 31	453.52	Mar. 16	455.72
22.	Peoria, upper bridge					Mar. 28	459.20	Mar. 12	455.73	July 22	457.17	Mar. 31	453.77	Mar. 12	456.11
23.	Chillicothe					Mar. 28	460.11								
24.	Lacon					Mar. 28	460.75								
25.	Henry, below lock					Mar. 28	460.14	Mar. 10	455.74	July 21	458.54	Mar. 31	455.14	Mar. 15	457.64
26.	Henry, above lock					Mar. 28	460.99	Mar. 10	457.19	July 21	450.19	Mar. 31	455.34	Mar. 15	458.49
27.	Hennepin														
28.	Depue														
29.	Peru														
30.	LaSalle, Lock 15					Mar. 27	464.56			July 20	462.31				
31.	LaSalle, wagon bridge	Feb. 25	456.25	May 13	459.15										
32.	Morris	Jan. 23	496.36	May 13	500.51	Mar. 26	506.10							Mar. 12	505.45

TABLE NO. 13—Continued.

	1899		1898		1897		1896		1895		1894		1893	
	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1. Grafton	May 25	429.15	May 23 Apr. 7	428.95 424.65	May 2 Apr. 6	434.16 433.56	May 30	429.06	Dec. 22	425.36	May 12	425.36		
2. Hardin														
3. Kampsville, below lock	May 27	430.60	Apr. 7	435.35	Apr. 6	436.60	May 30	429.70	Dec. 21	427.10	May 12	426.25	May 5	436.97
4. Kampsville, above lock	May 29 Mar. 25	430.98 430.23	Apr. 7	435.58	Apr. 6	436.83	May 30	429.78	Dec. 22	427.63	May 12	426.63		
5. Pearl	Mar. 25	432.20	Apr. 6	438.03	Apr. 7	438.03	May 31 Jan. 2	420.70 427.73	Dec. 27	428.60	May 12 Mar. 22	427.00 427.60	May 5	437.80
6. Valley City	Mar. 25	436.50	Apr. 4	441.21	Apr. 6	440.75	Jan. 2	433.50	Dec. 31	433.08	Mar. 22	430.35	May 5	440.55
7. Meredosia	Mar. 15	438.72	Apr. 4	444.22	Apr. 4	442.55	Jan. 3	435.89	Dec. 31	435.42	Mar. 22	432.14	May 4	442.39
8. LaGrange, below lock	Mar. 14	439.63	Apr. 3	445.03	Apr. 4	443.18	Jan. 3	437.58	Dec. 31	437.08	Mar. 23	433.93	May 5	442.83
9. LaGrange, above lock	Mar. 14	439.98	Apr. 3	445.18	Apr. 4	443.33	Jan. 3	438.33	Dec. 31	438.08	Mar. 23	435.93	May 5	443.03
10. Beardstown	Mar. 14	441.35	Apr. 1	447.15							Mar. 23	437.05	May 5 Mar. 14	444.05 444.25
11. Browning														
12. Sharps Landing														
13. Chandlerville														
14. Bath														
15. Havana	Mar. 14 Mar. 22	444.87 445.37	Apr. 2	449.67	Mar. 28	447.67	Jan. 2	444.27						
16. Liverpool														
17. Copperas Creek, below lock	Mar. 22	446.55					Jan. 1	445.85	Dec. 31	445.85	Mar. 23	443.15	Mar. 14	450.55
18. Copperas Creek, above lock	Mar. 22	446.73	Apr. 2	450.93	Mar. 27	449.53	Jan. 1	446.13	Dec. 31	446.13	Mar. 20	443.53	Mar. 14	450.73
19. Kingston Mines														
20. Pekin														
21. Peoria, lower bridge	Mar. 22	450.92	Mar. 31	455.12	Mar. 26	454.12	Jan. 1	450.52	Dec. 31	450.82	Mar. 14	448.12	Mar. 15	455.72
22. Peoria, upper bridge	Mar. 22 Mar. 2	451.12 450.57	Mar. 31	455.27	Mar. 24	454.17	Jan. 1	449.77	Dec. 29	450.62	Mar. 14	447.97		
23. Chillicothe														
24. Lacon														
25. Henry, below lock	Mar. 6	452.04	Mar. 30	456.84	Mar. 24	455.74	Jan. 1	450.94	Dec. 28	452.04	Mar. 12	449.04	Mar. 11	457.34
26. Henry, above lock	Mar. 6	452.23	Mar. 30	456.93	Mar. 24	455.83	Jan. 1	451.03	Dec. 28	452.33	Mar. 11	449.98	Mar. 11	457.43
27. Hennepin														
28. Depue														
29. Peru														
30. LaSalle, Lock 15														
31. LaSalle, wagon bridge														
32. Morris					Mar. 24 Jan. 5	498.05 501.75	Jan. 1 Feb. 28	491.85 494.35	Dec. 21	502.05	Mar. 8	495.55		

TABLE NO. 13—Continued.

		1892		1891		1890		1889		1888		1887		1886	
		Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1.	Grafton	May 18	436.65	Apr. 26	425.85	June 30 Jan. 16	425.60 419.20	May 31 June 1	425.35 425.15	May 30	433.36	Feb. 16 Feb. 28	424.61 422.15	May 15 Feb. 27	429.43 423.61
2.	Hardin														
3.	Kampsville, below lock	May 19	439.62	Apr. 26	428.97	Jan. 16	427.62	June 1	427.47	May 30	427.47	May 30	435.47		
4.	Kampsville, above lock														
5.	Pearl	May 19	440.20	Apr. 26	430.45	Jan. 19	429.65	July 4	428.87	May 30	434.87	Feb. 28	434.45	Feb. 27	433.78
6.	Valley City	May 18	442.35	Apr. 26	434.55	Jan. 21	434.75	July 4	433.35	May 30 Apr. 5	435.58 435.75	Feb. 25	439.40	Feb. 27	438.75
7.	Meredosia	May 18	443.92	Apr. 26	436.64	Jan. 21	437.14	July 4	435.80			Feb. 25	441.64	Feb. 27	440.97
8.	LaGrange, below lock	May 17	444.48	Apr. 26	438.03	Jan. 21	433.41	July 3	437.26	Apr. 5	439.08	Feb. 25	442.38	Feb. 26	441.98
9.	LaGrange, above lock	May 17	444.58	Apr. 26	438.48										
10.	Beardstown	May 16	445.65	Apr. 26	440.05	Jan. 20	440.75	July 3 June 27	439.15 439.25	Apr. 5	440.75	Feb. 25	443.75	Feb. 26	443.25
11.	Browning														
12.	Sharps Landing														
13.	Chandlerville														
14.	Bath														
15.	Havana														
16.	Liverpool														
17.	Copperas Creek, below lock	May 11	451.55	Apr. 23	446.35	Jan. 20 Apr. 20	444.15 444.85	June 28	443.95	Apr. 3	446.55	Feb. 22	449.00	Feb. 22	447.90
18.	Copperas Creek, above lock	May 11	451.73	Apr. 23	446.53	Apr. 20	445.03	June 27	444.03	Apr. 3	446.63	Feb. 22	450.28	Feb. 22	448.08
19.	Kingston Mines														
20.	Pekin	May 9	453.65												
21.	Peoria, lower bridge	May 9	457.72	Apr. 18	450.82	Apr. 20 June 26	448.82 449.12	June 25	446.82	Apr. 1	449.92	Feb. 19	454.62	Feb. 20	451.82
22.	Peoria, upper bridge														
23.	Chillicothe														
24.	Lacon														
25.	Henry, below lock	May 7	460.34	Apr. 16	452.64	June 24	450.94	June 23	448.24	Mar. 5	451.84	Feb. 20	457.34	Feb. 19	454.44
26.	Henry, above lock	May 7	460.43	Apr. 15	453.03	June 24	451.13	June 22	448.53	Mar. 4	452.13	Feb. 20	457.53	Feb. 19	454.53
27.	Hennepin														
28.	Depue														
29.	Peru														
30.	LaSalle, Lock 15														
31.	LaSalle, wagon bridge														
32.	Morris														
33.	Joliet														

TABLE NO. 13—Concluded.

	1885		1884		1883		1882		1881		1880		1879	
	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.
1. Grafton	Apr. 29 Jan. 22	428.24 419.76	Apr. 6	432.05	June 25 Mar. 1	434.30 431.05	July 8	434.58	May 5	433.83	July 9	430.01		
2. Hardin													Apr. 25	424.31
3. Kampsville, below lock					Mar. 1	438.20	July 7	436.20	May 5 Nov. 21	434.86 435.20	July 9	428.67	Apr. 25	425.57
4. Kampsville, above lock														
5. Pearl	Jan. 22	436.28							May 2	436.30	July 9	431.40	Apr. 25	428.30
6. Valley City	Jan. 20	438.82	Apr. 5	439.95							May 21	435.85	Apr. 24	433.05
7. Meredosia	Jan. 20 Apr. 29	440.17 440.47	Apr. 5	441.72					May 2 Mar. 20	440.22 441.62	May 21	438.32	Apr. 24	435.72
8. LaGrange, below lock	Jan. 13	441.53	Apr. 4	442.58	Feb. 25	447.03								
9. LaGrange, above lock														
10. Beardstown	Jan. 12	443.35	Apr. 3	443.85	Feb. 25	449.05	July 7 June 16	442.60 445.05	Mar. 20 Dec. 31	443.25 443.35	May 19	440.65	Apr. 24	438.95
11. Browning														
12. Sharps Landing											May 17	442.59	Apr. 21	440.89
13. Chandlerville														
14. Bath														
15. Havana									Mar. 20	447.37	May 17	444.97	Apr. 20	443.09
16. Liverpool														
17. Copperas Creek, below lock	Jan. 12	447.60	Apr. 1	449.25	Feb. 25	452.00	June 16 Jan. 1	448.40 448.55	Mar. 21	449.10	May 16	446.30	Apr. 18	444.35
18. Copperas Creek, above lock	Jan. 12	447.78	Apr. 1	449.48	Feb. 25	452.48	Jan. 1	448.73	Mar. 21	449.18	May 16	446.43	Apr. 18	444.68
19. Kingston Mines														
20. Pekin														
21. Peoria, lower bridge	Jan. 12 Apr. 23	450.05 451.12	Mar. 30	453.62										
22. Peoria, upper bridge														
23. Chillicothe														
24. Lacon														
25. Henry, below lock	Apr. 22 Mar. 21	452.84 452.94	Mar. 29	456.14	Feb. 23	458.44	Mar. 5	452.39			May 14	451.47	Mar. 17	449.27
26. Henry, above lock	Mar. 21 Apr. 21	453.13 453.18	Mar. 29	456.33	Feb. 24	458.63	Mar. 5	452.98	Mar. 20 Dec. 25	455.43 455.63	May 14	451.78	Mar. 14	449.76
27. Hennepin														
28. Depue														
29. Peru														
30. LaSalle, Lock 15														
31. LaSalle, wagon bridge														
32. Morris														
33. Joliet														

In Appendix B, Figures Nos. B-11 to B-48, are shown, hydrographs of daily river stages of the Illinois River at Grafton, Pearl, Beardstown, Havana, Peoria, LaSalle and Morris for the complete years, 1890 to 1927, inclusive. Hydrographs, Figures Nos. 19 and 20 cover the flood periods 1926 and 1927 for the stations Grafton to LaSalle, and Figures Nos. 21 and 22 for stations Grafton to Peoria in the period of the October 1926 flood on an enlarged scale to show the effect of the levee breaks.

DISCHARGE.

In 1900 Mr. Jacob A. Harman made seven measurements of the discharge of the Illinois River at Peoria. These were made for the Illinois State Board of Health and are published in their report on "Sanitary Investigations of the Illinois River and Tributaries" in 1901 on page 135, with rating curves inserted at page 174.

In 1903 to 1904, during the periods of high water, measurements were made of the discharge of the Illinois River by the U. S. Geological Survey at Havana, Peoria, LaSalle, Ottawa and Divine, also by the U. S. Engineers at 12-Mile Island, Pearl, Beardstown, Havana, Peoria, Henry and Ottawa. The results of the U. S. Geological Survey measurements are published in "Water Resources of Illinois" in 1914, and those made by the U. E. Engineers together with the few measurements made prior thereto in House Document 263, Fifty-ninth Congress, First Session.

The more recent flood measurements of the Illinois River and its tributaries have been made by the U. S. Geological Survey, U. S. Engineers and the Sanitary District of Chicago.

In Water Supply Papers published annually by the U. S. Geological Survey are to be found the results of other stream gages in Illinois. They are made in co-operation with the State of Illinois, an arrangement whereby the work is done by the observers of the U. S. Geological Survey and the files with the results are kept for reference in the office of the Division of Waterways in Chicago.

The curves in Figure No. 23 are reproduced for the purpose of comparing the discharge measurements before the era of levee construction and shows three (3) rating curves, as follows: (1) by Jacob A. Harman from discharge measurements made in 1900; (2) by the U. S. Engineers from discharge measurements made in 1904 and (3) by the U. S. Geological Survey from discharge measurements made 1903 to 1906.

PRESENT CONDITION OF RIVER AS LEVEED.

The levee construction in the lower Illinois River Valley, which was commenced before 1900 and continued until about 1922, altered materially the flow carrying channel of the river. About 1922 nearly all the levees were completed that brought the channel to the condition which we have today. The last of the levees to be constructed were started from 1918 to 1921 and were nearly completed in 1922. Since the completion of the levees there have been three main floods. The floods of recent years of great magnitude were in 1904, about the time of

the beginning of levee construction, 1913 when it was well under way, and 1916 which was abnormal because of the breaking up of the ice forming jams above LaSalle and causing irregular flow.

In 1922 the following districts were probably still under construction:

District.	Organization.	Area in Acres.
Chautauqua	1918	3,500
Thompson Lake	1918–1921	5,600
Seahorn	1919	1,470
Lost Creek	1920	2,400
Valley City	1920	4,750

Since 1921 some of the levees have been strengthened and raised.

LIST OF DISCHARGE MEASUREMENTS.

The details of the more recent discharge measurements, only a few of which have been published, are given in Table No. B-4, Appendix B. These measurements were made under the present river conditions and are those used in the derivation of discharge rating curves and diagrams. They show the river stages at the time of observation, the areas, depths and widths of sections and the authorities.

a. Methods.—The U. S. Engineers and the U. S. Geological Survey observed the velocity at two-tenths and at eight-tenths of the depth below the surface and applied a co-efficient of 1.00 to obtain the mean velocity at each station or station area. The Sanitary District of Chicago observed the velocity at sub-surface points either one foot or two feet below the water surface and applied a co-efficient of .90 to obtain the mean.

b. Equipment.—Price meters were used by all observers and in general these were of the small Gurley type—in a few cases the large size meter was used.

c. Rating.—Meters of the Sanitary District of Chicago were rated when purchased and once a year thereafter. Copies of these ratings indicate but slight seasonal changes in rate. Meters of the U. S. Geological Survey and U. S. Engineers are rated periodically.

d. Rate Comparisons.—A comparison of meter rates was made by observers of the Sanitary District of Chicago and U. S. Geological Survey by running meters simultaneously side by side at Beardstown on April 28, 1927. The results showed the U. S. Geological Survey meter giving velocities 2.7 per cent greater than the Sanitary District of Chicago meter.

e. Velocities in the Vertical Plane.—Only a few measurements were made by any of the authorities to determine the variation of the velocity in the vertical section to test the velocity co-efficients which were used. On account of variation in discharge by different observers where measurements were comparable, a set of velocity measurements in vertical plane were later made jointly by observers of the U. S. Geological Survey and the Sanitary District of Chicago to check the co-efficients used. The results of measurements made at Peoria, Havana and Beardstown made in December 1928 indicate that there was no appreciable error in co-efficient.

f. Comparison of Observations.—At Beardstown on April 28, 1927 simultaneous measurements were made of the discharge of the river by observers of the U. S. Geological Survey and the Sanitary District of Chicago with results shown in Table No. 14.

TABLE NO. 14—COMPARISON OF SIMULTANEOUS DISCHARGE MEASUREMENTS.

Date.	Observer's number.	Authority.	Observed discharge C. F. S.	Residual from mean C. F. S.	Percentage variation.
April 28, 1926	44A	U. S. G. S.	87,600	4,020	4.8
April 28, 1926	44	S. D. C.	79,560	4,020	4.8
Mean			83,580		
Difference			8,040		9.6

At Beardstown two measurements were made of the discharge on different years under similar conditions of stage and slope such that the flows should not differ materially and gave results as follows:

TABLE NO. 15—COMPARISON OF DISCHARGE MEASUREMENTS MADE IN DIFFERENT YEARS WITH SIMILAR FLOW CONDITIONS.

Date.	Observers number.	Authority.	Stage.			Difference in elevation.		Observer's discharge C. F. S.
			Bath.	Beardstown.	LaGrange.	Bath–Beardstown.	Beardstown–LaGrange.	
Oct. 16, 1926	39	S. D. C.	453.36	452.77	449.81	0.59	2.96	77,190
Apr. 26, 1927	40	S. D. C.	453.26	452.35	449.28	.81	3.07	78,000

CURRENT METER DISCHARGE MEASUREMENTS CONDITIONS.

A tabulation giving the condition under which the flow was measured at the upper stages, will be found in Table No. B-5, Appendix B. On October 5th the water was over the lower chord of the Beardstown highway bridge for 740 feet out from the right abutment and debris was lodged along the upstream side of the bridge. One would expect under such conditions, with the water running thru the debris and steel work, that the flow in the upper two feet of the section would be retarded for a short distance above and below the bridge. The current meter was submerged one foot below the water surface, consequently even the flow measurements at elevations above 451, which are the most reliable source of information from October 5th to 12th, are probably too low.

STAGE DISCHARGE RELATION.

Ordinarily discharges are referred directly to the stage of a stream at the gauging station. The gauge heights are platted as ordinates and the discharges as abscissa, curves of discharge are then drawn through the intersection points giving the stage discharge relation. These are called rating curves. Observations falling to either side of this curve

are by some authorities corrected to the curve at the same stage by the rule that for a constant stage the discharges vary as the square root of the slopes. This is based on the Chezy Formula $v = c\sqrt{rs}$ or, since $q = av$, by substitution $q = ac\sqrt{rs}$, then for a constant slope—

$$\frac{q_1}{q_2} = \frac{a\,c\,r^{1/2}\ s_1^{1/2}}{a\,c\,r^{1/2}\ s_2^{1/2}} = \frac{s_1^{1/2}}{s_2^{1/2}}$$

On most streams for any stage there is very little variation in the slope or fall at the gauging station. At several places on the Illinois River, however, due to the back-water effect from the inflow of tributary streams and from the varying stage of the Mississippi River at the mouth there is a considerable variation in the fall at any stage and, consequently, discharges will fall far apart on either side of the rating curve. In other words, the curve will not always correctly give the discharge for the stage, and discharge measurements will give discharges that will vary considerably from that indicated by the curve, sometimes residuals being as much as 25 per cent or more.

A break in a levee causes abnormal conditions such that no regular stage-discharge or slope-stage-discharge relation exists while the district is filling and unless discharge measurements are available, the discharges can only be estimated or approximated.

RATING CURVES.

The rating curves of the U. S. Engineers are given in Figure No. 24. Figure No. 25 is a rating curve of the Sangamon River at Oakford, and Figure No. 26 of the Sangamon River at Chandlerville. The rating curves of the U. S. Geological Survey for the Illinois River and tributaries are given in Figure 27. The rating curves of the U. S. Geological Survey, U. S. Engineers and the Sanitary District of Chicago at Beardstown are compared in Figure No. 28.

STAGE-SLOPE-DISCHARGES.

To obtain a basis for reference that would take into account the slope or fall as well as the stage, diagrams were developed that give at once the relation of the stage (e), the slope (S), fall or difference in elevation (F) and the discharge (q).

Inspection and comparison of hydrographs of stages, discharges and slope or fall disclosed that in a general way the variation in discharge has a definite relation to the stage at the gaging station, and to the slope, or fall, to a gage immediately above or below the gaging station. It was also determined that for practical purposes this difference in elevation bore the same relation to the discharge as the slope at the gaging station. This was observed to be the case by inspection of the hydrographs of stage and fall when platted on the same sheet with the discharge-graphs.

The discharge diagram is based on the Chezy Formula.

Formula $v = c\ r^{1/2}\ s^{1/2}$. At any stage the discharge varies as the square root of the fall or slope.

$$\frac{s_x^{1/2}}{s_m^{1/2}} = \frac{f_x^{1/2}}{f_m^{1/2}} = \frac{q_x}{q_m}$$

$$f_x = \left[q_x \left\{ \frac{f_m^{1/2}}{q_m} \right\} \right]^2$$

Where q_m, s_m and f_m are respectively the mean discharge, slope and fall of a discharge measurement, or center of gravity of a group of measured discharges, and q_x and s_x are respectively any other discharge and its corresponding slope.

From this formula "f" is computed for every 10,000 c. f. s. of discharge at the stage of an observation or group of observations. Figures Nos. 29 and 30 are Discharge Graphs at stations Peoria to Hardin for 1926 and 1927.

METHOD OF CONSTRUCTING A RATING DIAGRAM.

To illustrate the method of constructing a Typical Rating Diagram, Figure No. 31 was drawn from seven groups of actual discharge measurements made at Peoria. The following is an explanation of its construction:

(1) Plat each discharge referred to its stage as ordinate, and to its fall, Peoria to Pekin, as abscissa.

(2) Note the clusters of observations in close agreement as to stage, fall and discharge, such as Obs. Nos. 8 and 10, also Nos. 56 and 55. Compute (see Table No. 16 following) the mean or center of gravity of each cluster as (b_1) and (b_2). For each center of gravity compute the Co-ordinates for a common discharge, as 30,000 c. f. s. Cluster b_1 gives a fall of 1.08 at its stage of 456.67, and cluster b_2 a fall of 1.04 at its stage of 456.37. Use the means,—fall = 1.06, stage = 456.52 and discharge = 30,000 c. f. s. as group (b). Similarly compute and plat sets (a) (c) (d) (e) (f) and (g).

(3) Draw a smooth discharge curve A B (30,000 c. f. s.) thru the points a, b, c, d, e, f and g. Other curves as C D (40,000 c. f. s.) etc. can be similarly obtained. Take off (as noted on the plat) the fall (f_m) from this line at every foot of stage. From the fall (f_m) as scaled and the discharge (q_m) = 30,000 c. f. s. on each foot of stage compute the discharge q_x for every tenth or two-tenths of a foot of fall over the desired range (in this case from 0.8 to 3.0).

TABLE NO. 16—TYPICAL COMPUTATION FOR GROUPING DISCHARGE MEASUREMENTS.

Station.	Authority.	Observation number.	Cluster.	Group.	Elevation Peoria. (e)	Observed fall Peoria to Pekin. (f)	Observed discharge. (q_m)	Reference discharge. q_x	Computed fall Peoria and Pekin $f_x = q_x \left[\left\{ \frac{f_m}{q_m} \right\}^{\frac{1}{2}} \right]^2$ Discharge in thousands c. f. s.							
									80	70	60	50	40	30	20	10
Peoria	U. S. G. S.	8			456.96	2.04	44,000									
	U. S. G. S.	10			456.38	2.31	41,200									
		Mean	b_1		456.67	2.18	42,600	30,000						1.08		
	U. S. Engrs.	56 55			456.42 456.32	1.45 1.75	33,640 40,620									
		Mean	b_2		456.37	1.60	37,130	30,000						1.04		
				b	456.52			30,000						1.06		

(4) Establish discharges as co-ordinates on the same sheet so that discharge 10,000 c. f. s. corresponds to fall 1.0, 20,000 corresponds to 2.0, etc. Plat the falls (f_x) computed for each stage and join the points for each fall to form curve of fall.

(5) This gives a diagram from which can be read the discharge for any stage and fall.

COMPARISON OF OBSERVED AND DIAGRAM DISCHARGES.

Observed and diagram discharges are compared in Tables, Nos. B-6 to B-10, which appear in Appendix B.

The differences in discharge are called residuals. Where the measurements are all made in one period and by one observer, a diagram derived from that will generally have small residuals for the reason that a diagram is made to conform to the observations.

Observers making measurements in different periods when conditions vary will obtain results which may give a diagram with larger or smaller residuals. This is due to several reasons. There may be a personal factor, or it may be due to the different methods of observations, where it is noted that one authority finds his results giving plus residuals, while another working in a different period will obtain from his results practically all minus residuals. This condition may, however, be due to the fact that references to stage and fall is not an absolute measure, but it considered a better criterion than other measures.

DIAGRAM AND RATING CURVE DISCHARGES COMPARED.

There is given in Appendix B, Tables No. B-11, B-13 on which are compared diagram and curve discharges. At the higher discharges the slopes vary, more than those of the lower stages, and unless all are reduced to a common slope for comparison, the disagreement obtained as in Figure No. 28 will occur.

RATING DIAGRAMS.

Rating Diagrams have been prepared on a large scale for use in the study of the discharges at the following places, namely:

Peoria—Referred to Stage at Peoria and Fall Peoria to Pekin.

Havana—Referred to Stage at Havana and Fall Havana to Bath.

Beardstown—Referred to Stage at Beardstown and Fall Beardstown to LaGrange.

Pearl—Referred to Stage at Valley City and Fall Valley City to Pearl.

Hardin—Referred to Stage at Kampsville and Fall Kampsville to Grafton.

DISCUSSION OF DISCHARGES.

The discharge measurements that are available and used in this report were made by experienced observers. Reference has been made to the adverse conditions encountered, such as levee breaks, inflow from flashy tributaries and accumulation of debris on bridge sections.

Meters have been rated periodically to determine whether or not there has been a change in rate during the season. It is probable that

temporary changes in rate would be detected by the use of a second meter during discharge measurements by running meters simultaneously on the gaging section daily.

Very few observations were made by any of the authorities to determine the variation of velocity in the vertical plane. It is probable that a more accurate determination of the discharge would be obtained if, thruout a series of measurements, such observations were made at several stations in the cross-section and while the water is at high, intermediate and low stages.

These studies reveal the necessity for more gages to be read in time of flood flows for better determination of the changes in slope.

It would be possible to detect whether or not personal factor enters into the measurements if observers would periodically make simultaneous measurements of the discharge at the same station. Thus we find that at Havana measurements made by the U. S. Engineers are relatively high as compared to those of the Sanitary District of Chicago when referred to a common rating curve or diagram, but they were made at different periods, in different years, under different conditions and using different methods. If each had made two or three measurements in the authorized seasons, and simultaneous with those of the observations, a better analysis of the measurements could be made.

MAXIMUM STAGE.

Investigation of the height to which the river would have risen in the flood of 1926 had there been no levee breaks has been made a subject of considerable study. They led to the development of normal back water curves. Also calculations, involving discharge and storage, were made to determine the normal maximum stages.

As the volume of flow entering a section of the river must be either passed along or stored, the inflow and outflow-storage have been equated in various periods. A balance of flow for the period October 1st to October 19th, Table No. 17 has been drawn. It shows how much of the flow in a definite period remains unaccounted for when the equation $I+T+D=O+S+L$, in which I is the inflow passing a river section, T the inflow from tributary, D the outflow from levee districts, O the outflow thru the lower river section, S the quantity stored in the reach of the river and L the quantity discharged into the levee disrticts. In the period from October 5th to October 12th the total quantity discharged into the levee districts at crest stage is known. (See Table No. 18.)

SECTION III—FLOODS.

DISCUSSION OF FLOODS OF 1904, 1913, 1922, 1926 AND 1927.

Floods are of various types and differ according to the distribution and intensity of rainfall and the condition of the watershed to facilitate the rapidity of run-off from the tributaries into the main stream.

The floods of the past quarter century on the Illinois River have been investigated and studied more than those preceeding because the

TABLE NO. 17—BALANCE SHEET OF FLOW.

Reach.		Dates—1926.		Days.	Inflow. Ib	Tributaries. Tc	Levee districts. Dd	Unaccounted for. X1	Total in. I+T	Outflow. Oe	Storage. Sf	Through levees. Lg	Unaccounted for. X2	Total out. O+S+L	Unaccounted for (mean per day). X1—X2
From.	To.	From.a	To.a												
Peoria	Havana	Oct. 1	Oct. 5	4	165,300	82,550	0	--------	247,850	203,640	22,430	0	2,178	247,850	+5445
Peoria	Havana	Oct. 5	Oct. 12	7	384,500	122,150	0	--------	506,650	385,050	12,170	74,850	34,580	506,650	+4940
Peoria	Havana	Oct. 12	Oct. 19	7	302,350	54,480	8,340	7,890	373,060	391,480	—18,420	----------	--------	373,060	—1126
Havana	Beardstown	Oct. 1	Oct. 5	4	203,640	109,000	0	--------	312,640	241,970	62,300	0	8,370	312,640	+2092
Havana	Beardstown	Oct. 5	Oct. 12	7	385,050	315,600	0	--------	700,650	568,990	55,310	72,300	4,050	700,650	+579
Havana	Beardstown	Oct. 12	Oct. 19	7	391,480	161,600	10,300	--------	563,380	526,880	—43,210	----------	79,710	563,380	+11230
Peoria	Beardstown	Oct. 1	Oct. 5	4	165,300	191,550	0	--------	356,850	241,970	84,730	0	30,150	356,850	+7538
Peoria	Beardstown	Oct. 5	Oct. 12	7	384,500	437,750	0	--------	822,250	568,990	67,020	147,150	39,090	822,250	+5584
Peoria	Beardstown	Oct. 12	Oct. 19	7	302,350	216,180	18,640	--------	537,170	527,050	—61,630	----------	71,750	537,170	+10250
Beardstown	Pearl	Oct. 1	Oct. 5	4	241,970	60,410	0	22,240	324,620	300,950	23,670	0	--------	324,620	—5560
Beardstown	Pearl	Oct. 5	Oct. 12	7	568,990	119,620	0	--------	688,610	552,410	17,000	89,900	29,300	688,610	+4120
Beardstown	Pearl	Oct. 12	Oct. 19	7	527,050	66,730	11,510	35,350	640,640	653,050	—12,410	----------	--------	640,640	—3406

Notations—
- (a) At 7 A. M.
- (b) For Peoria used Diagram Discharge; for Havana used Observed Discharge; for Beardstown used Observed Discharge; for Pearl used Observed Discharge.
- (c) Used Discharge of day preceding (U. S. G. S.). Added percentages for run-off below gaging stations, as follows: Mackinaw River 47; Spoon River 47; Sangamon River 8.7; Crooked Creek 128, and used the additions on the date of the Discharge at gaging station.
- (d) Flow into river from open Levee Districts.
- (e) Same note as (b).
- (f) Storage in River=Rise X Area.
- (g) Discharge into Levee Districts through breaks in levees.

reclamation in the valley, beginning about 1900, so increased the value of the bottom lands, that a knowledge of the effect of alteration of the channel became a matter of economic importance, increasing as the improvements spread over a greater portion of the area.

In 1904 a flood crest was built up in a period of some two months, gradually increasing the stage at all stations from LaSalle to Grafton, culminating in a more rapid rise for ten days preceding the crest, at the rate of approximately four to five inches per day at Beardstown, Havana and Peoria. The crest moved down stream at a uniform rate from Peoria to Pearl and reached Grafton about the same time as the crest of the Mississippi River flood.

The next large flood, that of 1913, came when the levee construction was well underway. Its peak was built up more rapidly. After having been at bank-full for the preceding two months, it suddenly rose at an average rate of 10 inches per day at Beardstown, Havana and Peoria. The crest moved down stream at a very uniform rate from LaSalle to Pearl and also synchronized at Grafton with a crest on the Mississippi.

The 1922 was the first large flood to occur after levee construction had brought the channel into its present contracted condition. The building up of the flood from bank-full was steady for a month, culminating in a uniform rise of six inches per day at Beardstown, Havana and Peoria for five days as the crest approached. The rate of movement down stream was the most uniform of any flood of recent years, all the way from Morris to Grafton and arrived there at exactly the same time as a Mississippi crest. This flood provides the best data for study of unobstructed crest wave travel. It was made the subject matter of a special report, published in 1922 by the Division of Waterways entitled, "Floods in Illinois."

The flood of October, 1926, the record flood to date for stages in the middle reach of the river, has received its due share of observation, investigation and study. The hydrograph shows that it was built up to a considerable height in September, then receded and began to rise again on October 1st. The rate of rise was nine inches per day at Beardstown, and eight inches per day at Havana.

The movement of the crest down stream was interrupted by the inflow from the tributaries. From the first of October the Sangamon River at Chandlerville was rapidly rising until the crest on the afternoon of the 6th, then it proceeded to fall rapidly for the next two weeks. The effect upon the Illinois River profile is indicated in Figure No. 32, in which the profile of October 5th is drawn as a horizontal reference line and the stages of the following two weeks are referred to it. The same depressions in the lines, due to the levee breaks occurring between the 5th and the 12th, appear here as on the regular profile. Browning is at the mouth of the Sangamon. Note that the maximum effect every day is at this place. Following the line for the 7th a depression is found at Copperas Creek when the levee breaks caused the withdrawal of water. Below Copperas Creek the depression was counteracted by the large overflow from the Sangamon on the 7th and 8th. The crest

wave coming down stream started from Peoria on the 9th, passed Pekin and Kingston Mines on that date, and continuing without accretions would probably have passed Browning on the 10th. The tributary inflow and the breaking of levees influenced the cresting below Kingston Mines so that it occurred on the same date, October 12th, at all stations from there to Valley City. Here the crest wave was met by one coming up stream from Grafton, also depressed on account of levee breaks. The Mississippi crested in advance of the Illinois on the 6th, after which in falling it lowered the Illinois stage. This condition terminated the advance of the crest wave at Valley City.

During the period from the middle of September to the middle of October the engineers of the Sanitary District of Chicago made almost continuous discharge measurement of this flood at Havana, Beardstown and Pearl; these measurements, although made under adverse conditions and subject to the criticism of being made from sub-surface velocity observations only, are considered reliable and of such accuracy as to make one of the most valuable contributions of hydraulic data available in the Illinois River Valley.

The 1927 flood differs from the others in that it is made up of a high water period of four months, upon which there were created by short period of intensive rainfall distinct crests, of which one in April was the highest.

The numerous districts that were flooded in October, 1926 remained full of water, creating additional areas of storage and thus affecting the flood flows, but in a more uniform way than at times when the levees broke.

The flood crest moved down stream similarly to that of October, 1926, Flood (Figure No. 19), progressing regularly from LaSalle to Valley City. The Mississippi River crested a few days in advance of the Illinois.

DISTINCTION BETWEEN CREST PROFILE AND PROFILE OF A DATE.

The highest elevation that a flood reaches at the crest generally appears at an up-stream station earlier than at a station further downstream (disturbances causing exceptions) and the line joining the crests is called the "crest profile." The line joining the simultaneous elevations on a date is the profile of the date. Thus on April 22, 1927, Figure No. 19, a crest profile from LaSalle to Peoria compared with date profile would be as follows:

Station.	Elevation of water surface for crest profile.	Date, 1927.	Elevation of water surface for profile of date.	Date, 1927.	Difference in elevation.
LaSalle	464.1	Apr. 22	464.1	Apr. 22	0
Henry	461.7	Apr. 23	461.2	Apr. 22	0.5
Peoria	460.2	Apr. 24	459.8	Apr. 22	0.4

The run-off from the watershed below the gaging stations on main tributaries and along the small tributaries is an item of considerable moment when accounting for run-off between river discharge sections. This item has been taken as a percentage of the discharge at the main tributary gaging station, which is determined as the ratio of the area of the watershed above this station to the area of the watershed below it and between the river sections. Such a discharge volume is indicated by hatchures on the Crooked Creek Discharge Graph at the bottom of Figure No. 33.

LEVEE BREAKS.

In the October, 1926 flood there were 17 breaks in the levee, as follows:

District.	Date of Break-1926.	Acres.
Big Swan	September 3	11,850
Chautauqua	October 9	3,500
Coal Creek		6,390
East Liverpool	October 5	2,765
Fairbanks	October (2 or 10)	8,000
Hartwell	September 8	8,650
Hillview	September 4	12,318
Kelly Lake	October 6	985
Kerton Valley	October 7	1,741
Lost Creek	October 4	2,400
Mauvaisterre	September (8 or 9)	3,980
McGee Creek	October 7	10,080
Meredosia Lake	October 7	3,700
Pekin and LaMarsh	September 1	2,674
Scott County	September 9	9,200
Valley City	September 8	4,750
West Matanzas	October 7	2,679
Total Acres		95,690

A number of the levees of the larger districts in the lower reaches of the river broke in September, so that the districts were filled at the time of this flood and did not materially affect the uniformity of flow, but acted as increased river storage area. The breaks occurring in the vicinity of gaging sections had a marked effect upon the flow causing irregular velocities, due to the outflow of water in the districts, and they occurred while the river was rising. After the crest as the stage lowered the water was drawn out of the districts and increased the volume to be carried, thereby affecting the flow for a considerable period.

STORAGE AND LEVEE DISTRICTS.

Table No. 18 gives the quantity of water which the various districts stored at the time of high water and shows the elevation of this high water and the area in acres in the districts at that time. Table No. 19, is very comprehensive and gives the storage capacity of all of the levee districts in the Illinois River Valley. This indicates the possibilities of the use of the levee districts as storage reservoirs.

TABLE NO. 18—STORAGE IN LEVEE DISTRICTS—1926.

Reach.	Date of break.	Levee district.	Miles above Grafton.	Elevation (M. D.) high water 1926.	1926 high water area.	1926 high water capacity.	
						In feet.	Cubic feet per second per day.
	1926						
Peoria to Havana	10-5	East Liverpool	128-132	456.1	2,300	38,800	19,400
Peoria to Havana	10-5	Banner	137-146	457.2	2,780	41,600	20,800
Peoria to Havana	10-9	Chautauqua	124-130	456.1	3,780	69,300	34,650
Total					8,860	149,700	74,850
	1926						
Havana to Beardstown	10-6	Lacey-Langellier	118-119	455.0	5,290	69,000	34,500
Havana to Beardstown	10-6	Kelly Lake	100-103	454.5	1,040	15,200	7,600
Havana to Beardstown	10-7	Kerton Valley	112	454.8	1,770	13,900	6,950
Havana to Beardstown	10-7	West Matanzas	113-116	454.8	3,340	46,500	23,250
Total					11,440	144,600	72,300
	1926						
Beardstown to Pearl	10-5	Kerr	78-79	450.3	470	4,400	2,200
Beardstown to Pearl	10-5	Kerr-Crane	75-78	450.3	1,040	15,100	7,550
Beardstown to Pearl	10-7	Meredosia	66.5-67.5	450.1	5,300	36,300	18,150
Beardstown to Pearl	10-7	McGee's Creek	67.5-75	449.3	10,900	124,000	62,000
Total					17,710	179,800	89,900

TABLE NO. 19—LEVEE DISTRICTS IN ILLINOIS RIVER VALLEY, SHOWING AREA IN ACRES AT FLOOD PLANE OF 1926 AND STORAGE CAPACITY BELOW THAT PLANE, IN ACRE-FEET.

(1) District number.	(2) Name of district.	(3) County.	(4) Elevation 1926, H. W.	(5) River station.	(6) Area at flood elevation.	(7) Storage, acre-feet.
1	Hennepin	Putnam	462.1	1,081	2,600	41,000
2	East Peoria	Tazewell	460.5	851	840	10,200
3	Pekin and LaMarsh	Peoria	459.3	805	2,260	35,300
4	Rocky Ford	Tazewell	458.7	790	1,120	15,500
5	Spring Lake	Tazewell	456.9	744	12,700	206,600
6	Banner Special	Fulton and Peoria	457.2	749	2,780	41,600
7	East Liverpool	Fulton	456.1	686	2,340	38,800
8	Liverpool	Fulton	456.1	672	2,470	41,700
9	Chautauqua	Mason	456.1	665	3,780	69,300
10	Thompson Lake	Fulton	455.4	651	5,050	92.800
11	Crabtree (private) open	Fulton	455.5	648	1,181	12,300
12	Spoon River (private) open	Fulton	455.5	648	311	2,100
13 14	Lacey Langellier	Fulton	455.0	622	5,290	69,000
15	West Matanzas	Fulton	454.8	602	3,340	46,500
16	Seahorn	Fulton	454.6	610	1,300	10,700
17	Kerton Valley	Fulton	454.8	613	1,770	13,900
18	Big Lake	Schuyler	454.6	557	2,930	47,200
19	Kelly Lake	Schuyler	454.5	535	1,040	15,200
20	Coal Creek	Schuyler	453.6	469	6,650	99,300
21	Lost Creek	Cass	453.6	475	1,290	10,300
22	Crane Creek	Schuyler	452.3	445	4,900	57,700
23 24	South Beardstown Valley	Cass	452.8	455	6,760	121,000
25	Big Prairie	Brown	451.6	433	2,070	27,600
26	Meredosia Lake	Cass and Morgan	450.1	401	5,300	36,300
27	Willow Creek	Morgan		395		0
28	Little Creek (Kerr, Kerr-Crane)	Brown	450.3	405	1,510	19,500
29	McGee Creek	Brown and Pike	449.3	375	10,900	124,000

TABLE NO. 19—Concluded.

(1) District number.	(2) Name of district.	(3) County.	(4) Elevation 1926, H. W.	(5) River station.	(6) Area at flood elevation.	(7) Storage, acre-feet.
30	Coon Run	Morgan and Scott	448.5	365	1,300	1,800
31	Oakes (private)	Scott	448.2	345	3,600	19,800
32	Mauvaisterre					
33	Scott County	Scott	446.8	316	9,600	93,800
34	Valley City	Pike	448.0	340	5,400	64,800
35	Big Swan	Scott	444.6	282	12,100	129,100
36	Hillview	Scott and Green	442.2	246	10,800	96,000
37	Hartwell	Green	441.2	214	8,910	91,900
38	Fairbanks	Green	440.8	187	7,880	69,700
39	Eldred	Green	440.3	147	8,610	103,200
40	Spankey	Green	438.7	124	820	3,700
41	Nutwood	Jersey and Green	438.6	100	9,610	88,900
*42	Hager Slough	Cass	454.0	489	6,200	41,500
*43	Grigg's Chapel					

* NOTE.—No levees.

SECTION IV. BACK WATER PROFILE COMPUTATIONS AND COEFFICIENT OF ROUGHNESS "n."

FLOW FORMULAS.

Formulas for computing uniform flow of water in open channels have been derived using as a basis known physical laws and extensive research and experimentation on artificial and natural channels. These formulas are well understood and accepted among Hydraulic Engineers. Among those most universally used are Kutter's and Manning's modification of the Chezy Formula. Satisfactory results are obtained by the use of either of these formulas, provided proper coefficients of roughness are used. From these and other investigations we have concluded that while the Manning Formula can be applied with a very nearly constant value of coefficient "n" of roughness for a given channel condition, the value of the coefficient for Kutter's Formula varies not only with the condition of the channel, but also inversely with the slope of the water surface. For this reason and for the further reason of its marked simplicity as compared to the Kutter Formula, the Manning Formula has been adopted for hydraulic computation in this report.

The Manning Formula is as follows: $v = \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$, in which "v" the average velocity of the water in a given cross section; "n" is the coefficient of roughness; "R" is the hydraulic radius in feet; "S" is the slope or fall expressed in decimals of a foot per foot of length.

The Diagram, Figure 34, for the Manning Formula platted on logarithmic scale, greatly facilitated the computations. With three known values of any of the four required, "S," "R," "n" and "v," the unknown may be determined directly from the diagram. As an illustration, enter the diagram at the intersection of "R" and "S" and follow the diagonal line "n v" to the diagonal "n" line representing the known value of "n" and read the velocity on horizontal line to the velocity

scale—or follow the "n v" line to the horizontal line representing the known velocity and read the value of "n" on the diagonal "n" line.

APPLICATION OF FLOW FORMULAS.

In applying any uniform flow formula to the condition of a stream such as the Illinois River, it is important that the value of the coefficient "n" be determined from as nearly as possible to actual flow conditions. The nearest approach to uniform flow in a natural stream occurs at flood crest, especially if the crest or trough stages persist for one or more days. For this reason particular attention was given to minor flood crests occuring in recent years, undisturbed by levee breaks, in the studies for determining the values of coefficients to be used in computing future flood heights.

In general the cross-section available for flood flow consists of two parts having widely different hydraulic factors; (1) the channel section including the prism of the river channel below and above low water stage (1901), and (2) the over-bank area including the area occupied by flood waters on both banks and extending from the channel section to high ground or to the levees. For convenience the Illinois River from Grafton to LaSalle has been divided into 49 reaches, in length varying from 5,000 feet to about 40,000 feet depending on physical conditions. The average cross-section areas and top widths were determined for each reach based on elevations at center of reach and tabulated for each foot of elevation from bank-full stage to several feet above high water. Tables of these cross-section areas are included and more fully described in Table No. B-2 in Appendix B. of this Report.

DETERMINATION OF COEFFICIENTS.

The values of coefficient "n" Maning's Formula for the river channel section were computed as a basis, selected reaches of the river being used, between Grafton and Peoria, in which the over-bank section is so small that it has very little effect on the total discharge. Stages and slopes were used from a number of minor flood crests of recent years with discharge taken from the rating diagrams developed from discharge measurements.

These computations disclosed nearly uniform values of "n" for channel and values of "n" for overflow well within recognized limits. These values of "n" when applied produce computed profiles, agreeing within small limits with observed crest stages at all gage stations.

COEFFICIENT "n" FOR CHANNEL—SELECTED REACHES.

Table No. 20 gives the result of computations to determine the coefficient "n" for the channel section of the Illinois River, based on selected reaches between Grafton and Peoria, where levees confine practically all of the flow to the channel section. Quantities "Q" were determined from the Rating Diagrams at Hardin, Pearl, Beardstown, Havana and Peoria respectively, with stages and slopes based on observed conditions, with the river thru each reach considered temporarily stationary, either at minor crests or troughs; "n" value for the overflow section was assumed as .080. It will be observed that over-bank areas in

TABLE NO. 20—COMPUTED VALUES OF "n" (MANNING'S FORMULA) CHANNEL SECTION OF ILLINOIS RIVER FOR SELECTED REACHES OF RESTRICTED OVERFLOW. "Q" BY RATING DIAGRAMS. STAGES AND SLOPES OF MINOR CRESTS 1923-1927.

Reach.	Station to station.	Elev. centerline of reach.	Slope.	Total Q	Over-bank section.						Channel Section.					
					Area.	P	R	n	v	Q	Area.	P	R	Q	v	n
Hardin	80-124	427.0	.0000421	40,700	841	523	1.61	.080	.182	153	15,685	1,028	15.3	40,563	2.58	.023
Hardin	80-124	431.3	.0000453	62,400	4,923	1,271	3.87	.080	.305	1,502	19,800	1,028	19.3	60,900	3.075	.023
Hardin	80-124	435.7	.0000280	79,700	11,630	1,473	7.90	.080	.38	4,420	24,629	1,028	24.0	75,280	3.05	.022
Kampsville-Pearl	166-227	437.7	.0000405	68,000	6,090	1,210	5.02	.080	.35	2,130	23,580	1,215	20.1	65,870	2.80	.025
Kampsville-Pearl	166-227	441.5	.0000332	89,800	11,740	1,420	8.30	.080	.44	5,160	28,820	1,215	23.8	84,640	2.93	.024
Florence Landing	264-299	433.3	.0000390	32,200	940	265	3.55	.080	.27	250	13,645	914	14.9	31,900	2.34	.0239
Florence Landing	264-299	440.3	.0000468	61,700	5,820	875	6.65	.080	.45	2,620	20,130	914	22.0	59,080	2.94	.0270
Florence Landing	264-299	444.1	.0000527	86,900	9,360	990	9.46	.080	.61	5,710	23,600	914	25.8	81,200	3.44	.0245
Reich's Landing	425-442	437.1	.0000280	22,600	290	395	0.74	.080	—	—	9,900	720	13.75	22,600	2.28	.0198
Reich's Landing	425-442	442.7	.0000410	43,200	3,250	550	5.90	.080	.40	1,300	13,870	720	19.2	41,900	3.02	.0230
Reich's Landing	425-442	446.3	.0000415	54,300	5,245	550	9.50	.080	.54	2,830	16,530	720	23.0	51,500	3.12	.0247
Havana	633-655	442.4	.0000202	15,000	2,029	854	2.38	.080	.14	284	11,555	1,042	11.09	14,716	1.27	.026
Havana	633-655	447.3	.0000202	30,600	6,450	930	6.9	.080	.30	1,940	16,620	1,053	15.8	28,660	1.72	.024
Havana	633-655	450.5	.0000135	33,800	9,440	935	10.1	.080	.315	2,973	19,900	1,060	18.8	30,827	1.55	.0245
Liverpool	655-676	443.0	.0000320	15,300	3,600	1,005	3.60	.080	.250	900	6,570	460	14.3	14,400	2.19	.0226
Liverpool	655-676	450.2	.0000520	39,700	12,320	1,250	9.90	.080	.61	7,520	9,870	477	20.7	32,180	3.25	.0248
Pekin Landing	790-807	444.7	.0000150	11,500	203	108	1.9	.080	—	—	9,210	712	13.0	11,500	1.25	.0253
Pekin Landing	790-807	451.4	.0000290	31,300	2,255	363	6.2	.080	.34	770	13,310	712	18.7	30,530	2.29	.0242
Pekin Landing	790-807	455.3	.0000380	48,000	3,670	363	10.1	.080	.54	1,980	16,048	712	22.5	46,020	2.87	.0250

the reaches selected are so small that any reasonable value of "n" for overflow area will not greatly modify the value of "n" for the channel section. It will also be noted that the difference in the values obtained for "n" may be due to using slope and cross-sections based on a straight line determination of water surface between existing gaging stations, which usually varies slightly from actual surface slopes in the comparatively short and narrow reaches under consideration.

Other computations for determination of "n" were made from simultaneous gage readings and discharge measurements at a number of stations. For these computations the weighted average cross-section *for the entire reach between stations where gage readings are available was used. This study included measured discharges made when river was approximately bank-full. Results from these studies were not satisfactory, the values derived varying too much to be of practical use.

Computations were also made to determine the value of the coefficient "n" for the channel section between Peoria and Grafton based on the flood crests of April 1927, October 1926 and April 1922. The quantities of flow used in these computations were "built up" by the rational method as follows: the discharges at the principal gaging stations were taken from the rating diagrams with stages and slopes derived from the flood crest profile, and then, proceeding down stream from one gage station to the next, building up discharges by adding increments for the inflow from tributary streams (taken from the Discharges Tables of the U. S. Geological Survey) and increments for tributary areas, not measured, at the rate in c. f. s. per square mile indicated by the rates of neighboring tributary streams for which discharges are available. Water surface elevations and slopes for these computations were taken directly from straight lines, connecting gage elevations for the crests of flood under consideration. Values of coefficient "n" for overflow areas were selected, ranging from .080 to .120 based on "cover" condition of the overflow areas, and the discharge for the overflow area computed and deducted from the total discharge for the section. The value of coefficient "n" for the remaining (channel section) was then computed. The results of these computations were not satisfactory, leading to marked variations in the coefficient values determined, no doubt due to inaccuracy of local slopes and disturbances of flow by breaks in levees.

Discharge quantities for the April 1926 flood crest between Grafton and Peoria were determined by using the Rating Diagram at Beardstown as a basis with additions based on U. S. Geological Survey discharge for the tributary streams, and a proportional increment for tributary areas, not measured, between Beardstown and Grafton, and with deductions made on a similar basis between Beardstown and Peoria.

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* NOTE: Method for obtaining the weighted average cross-section and the weighted average width of sections of the river consisting of more than one reach for back-water computations.

First.—Determine the water surface profile to which the areas are to be computed.

Second.—Find the area of the cross-section at the center of each reach to that profile.

Third.—Multiply the area of each reach by its length to obtain the volume.

Fourth.—Add the volumes of all the reaches.

Fifth.—Divide by the total length of all the reaches to obtain the weighted average cross-section.

Table No. 21 shows the quantities of Discharge "Q" for each reach from Beardstown to Peoria for flood crest of April 1926, and a comparison of these discharges, with discharges at gaging points from Rating Diagrams and from rating curves of the U. S. Geological Survey and the U. S. Engineer Corps.

By a series of trial computations the values of the coefficient "n" has been determined for the Illinois River between Grafton and Peoria under conditions prevailing during the crest of the flood of April 1926, which is one of the highest observed, under conditions of river channel not modified or influenced by levee breaks occuring near crest stages. Similar studies were made for that portion of the river between Peoria and LaSalle, using the April 1927 flood crest as a basis. The higher flood crest was adopted for this reach, as there were no levee breaks in this section of the river in 1927.

Table No. 22 gives the final results of the trial computations showing a nearly uniform value of "n" = .024 for channel coefficient for the April 1926 flood. Discharge quantities shown in Table No. 21 were used, and values of coefficient "n" of overflow sections ranged from .080 to .120 depending on the ratios of cleared land or lake beds to overflow areas. The computed water surface at the head of each reach, and the observed water surface at all river gages are given in the last two columns of Table No. 22. The computed profile and the observed crest profile are shown on Figure No. 36 of this report.

Table No. 23 shows the discharge quantities for the flood crest of April 1927 between LaSalle and Peoria arrived at by methods similar to those used in determining the quantities for April 1926 flood crest in Table No. 21. No rating diagrams were available above Peoria and the discharges from the U. S. Geological Survey Tables for the Illinois River at Morris, for the Vermillion River at Streator and for the Fox River at Dayton were used to determine flood flow at LaSalle. This flood crest stage was reached at LaSalle on the evening of April 21st and at Peru at noon on April 21st, while the crest stage at DePue was not reached until the night of April 22nd. From DePue to Peoria crest stages were reached almost silmultaneously. For this reason in determining the crest profile, the morning readings of April 23rd were used at both Peru and LaSalle as more nearly representing crest flow conditions.

To obtain the weighted average widths follow the same method by multiplying the width at the middle of each reach by the length of the reach to obtain the area of the reach, add the areas and divide the total by the sum of the length of all the reaches to obtain the average weighted width for the section.

With discharges for the flood crest of April 1927 between LaSalle and Peoria as set forth in Table No. 23, computations were made to determine values of coefficients "n" for the channel and overflow sections. The results of these computations are shown in Table No. 24. It will be noted that with a coefficient value of .025 for channel section and .080 for overflow, except for the reach between Chillicothe and Henry where the coefficient value of "n" for overflow is .120, the computed

TABLE NO. 21—ILLINOIS RIVER FLOOD CREST OF APRIL, 1926, DISCHARGE RATES FOR PRINCIPAL GAGING STATIONS AND REACHES FROM PEORIA TO GRAFTON.

Gage.	Stations of 1,000 ft. from Grafton.	Date.	Observed W. S. elevation.	Increments of tributary discharges.	Discharge "Q" at gaging stations in c.f.s.			
					"Q" as determined.	"Q" by rating diagrams.	"Q" by U. S. G. S. rating curve.	"Q" by U. S. Eng. rating curve.
Peoria	856+750	Apr. 15	456.22	Mackinaw at Greenvalley $= \frac{1{,}600 \text{ c.f.s.}}{1{,}100 \text{ sq. mi.}} = 1.5$ c.f.s. per sq. mi. Peoria to Pekin—475 sq. mi. at 1.5 c.f.s.= 700 c.f.s.	38,300	43,600	36,500	45,000
Pekin	807+350	Apr. 15-16	454.07	Mackinaw at Greenvalley (Apr. 15-26,)=1,600 c.f.s. Area Pekin to Copperas Creek 160 sq. mi. at 1.5 c.f.s.= 240 c.f.s.	39,000			
Copperas Creek	721+700	Apr. 16	451.58	Area Copperas Creek to Liverpool 210 sq. mi. at 1.5 c.f.s.= 320 c.f.s.	40,840			
Liverpool	676+000	Apr. 17	450.60	Area Liverpool to Havana 210 sq. mi. at 1.5 c.f.s.= 320 c.f.s. Spoon River at Seville (Apr. 16-17) = 1,870 c.f.s.	41,160			
Havana	633+300	Apr. 17	449.23	Havana to Bath. No increase	43,350	39,600	38,500	44,300
Bath	589+776	Apr. 17	447.96	Bath to Beardstown 485 sq. mi. at 1.3 c.f.s.= 630 c.f.s. Sangamon River at Oakford (Apr. 18) = 12,400 c.f.s.	43,350			
Beardstown	469+100	Apr. 17-18	446.90	Area Beardstown to LaGrange 380 sq. mi. at 1.3 c.f.s.= 490 c.f.s. Crooked Creek 1,310 sq. mi. at 1.0 c.f.s.= 1,310 c.f.s.	56,420	56,400	57,700	57,200
LaGrange	409+750	Apr. 18	{444.38 444.18}	LaGrange to Meredosia 520 sq. mi. at 1.5 c.f.s.= 780 c.f.s.	58,220			
Meredosia	375+250	Apr. 18	443.22	Meredosia to Valley City 440 sq. mi. at 1.5 c.f.s.= 660 c.f.s.	59,000			
Valley City	325+250	Apr. 18	441.46	Valley City to Pearl 180 sq. mi. at 1.5 c.f.s.= 270 c.f.s.	59,660			
Pearl	227+750	Apr. 18	435.60	Pearl to Kampsville 540 sq. mi. at .7 c.f.s.= 380 c.f.s.	59,930	63,600		
Kampsville	165+792	Apr. 18-19	{433.03 432.85}	Macoupin Creek (Apr. 18) = 290 c.f.s. Kampsville to Grafton 360 sq. mi. at .7 c.f.s.= 250 c.f.s.	60,310			
Hardin	115+100	Apr. 19	430.2		60,850	60,700		59,500
Grafton	0	Apr. 19	424.1		60,850			

TABLE NO. 22—COMPUTED PROFILE FLOOD CREST APRIL, 1926. GRAFTON TO PEORIA.

Station.	Total discharge "Q."	Slope = fall ÷ distance.	Over-bank section.						Channel section.						Computed W. S. elevation.	Observed W. S. elevation.
			Area.	P	R	n	v	Q	Area.	P	R	n	v	Q		
Grafton. 0	60,850														424.10	424.1
		.0000645	14,400	4,980	2.90	.110	.22	3,170	17,990	1,020	17.65	.0245	3.22	57,900		
50	60,850														427.32	
		.000058	17,260	5,390	3.20	.110	.22	3,800	17,562	930	18.9	.0245	3.26	57,200		
80	60,850														429.06	
Hardin. 115+104																
		.0000555	3,985	1,165	2.56	.110	.19	760	19,080	1,060	18.0	.0245	3.10	59,200		
124	60,490														431.50	
		.0000435	12,820	2,900	4.42	.110	.24	3,100	19,435	955	20.35	.0245	2.95	57,400		
Kampsville. 165+792	60,310														433.31	433.03
		.000045	2,620	835	3.15	.110	.185	508	21,530	1,227	17.6	.024	2.80	60,200		
201	60,100														434.88	
		.0000435	5,000	1,205	4.15	.110	.225	1,120	21,560	1,235	17.5	.024	2.75	59,300		
Pearl. 227+750	59,930														436.05	435.60
		.000054	5,780	1,238	4.65	.110	.27	1,560	18,645	1,035	18.0	.024	3.10	57,900		
264	59,800														438.11	
		.0000475	4,620	820	5.6	.110	.29	1,340	18,760	940	19.9	.024	3.12	58,500		
299	59,750														439.77	
		.000058	6,960	1,270	5.5	.110	.32	2,230	16,260	780	20.8	.024	3.55	57,700		
Valley City. 325+250	59,660														441.28	441.46
		.000046	9,380	1,375	6.8	.110	.325	3,050	18,280	900	20.3	.024	3.10	56,700		
354	59,350														442.61	
		.000031	22,890	2,335	9.4	.100	.37	8,460	19,260	885	21.75	.024	2.63	50,700		
Meredosia. 375+250	59,000														443.29	443.22
		.0000185	74,250	5,840	12.7	.100	.345	25,600	16,320	755	21.6	.024	2.06	33,600		
397	58,550														443.68	
		.0000143	97,650	8,750	11.1	.100	.275	26,800	17,755	845	21.0	.024	1.78	31,600		
LaGrange. 409+750	58,220														443.86 444.06	444.18 444.38
		.000038	36,000	3,875	9.3	.100	.40	14,400	16,150	840	19.2	.024	2.73	44,100		
425	57,880														444.64	
		.000048	4,525	550	8.2	.100	.41	1,850	16,590	740	22.4	.024	3.38	56,000		
442	57,600														445.46	
		.000043	5,650	750	7.5	.100	.37	2,090	19,000	960	19.8	.024	2.92	55,400		
452	57,240														445.89	
		.000046	8,320	950	8.75	.100	.42	3,500	17,740	890	19.9	.024	3.00	53,300		
462	56,820														446.35	
		.000035	7,900	950	8.30	.100	.36	2,850	19,760	958	20.6	.024	2.72	53,700		

Beardstown. 469+100	56,420													446.60	446.90
		.0000080	96,500	9,900	9.75	.080	.24	23,200	18,380	730	25.1	.024	1.48	27,200		
493	50,060													446.79	
		.0000072	158,100	20,950	7.55	.080	.186	29,400	13,075	676	19.3	.024	1.17	15,300		
526	43,700													447.03	
		.0000096	126,200	17,100	7.35	.080	.212	26,750	11,670	533	21.9	.024	1.47	17,150		
542	43,600													447.18	
		.0000175	72,400	8,800	8.20	.080	.31	21,500	12,360	640	19.3	.024	1.80	22,200		
572	43,500													447.71	
		.000010	103,100	11,250	9.15	.080	.255	26,300	13,430	760	17.6	.024	1.30	17,400		
Bath. 589+776	43,350													447.89	447.96
		.0000220	52,520	6,220	7.40	.080	.325	17,100	13,400	750	17.8	.024	1.97	26,400		
613	43,350													448.40	
		.0000430	10,070	1,280	7.85	.080	.475	4,750	13,720	720	19.05	.024	2.86	39,200		
Havana. 633+300	43,350													449.27	449.26
		.000022	13,560	1,225	11.05	.080	.43	5,820	19,260	1,140	16.9	.024	1.87	36,000		
655	41,320													449.75	
		.000050	14,480	1,170	12.40	.080	.70	10,120	9,380	435	21.55	.024	3.35	31,450		
Liverpool. 676+000	41,160													450.80	450.60
		.0000190	57,310	4,830	11.85	.100	.323	17,600	11,910	610	19.50	.024	1.94	23,150		
707	41,000													451.39	
		.000013	78,480	6,730	11.70	.100	.265	20,800	13,350	680	19.6	.024	1.49	19,900		
Copperas Creek. 722+300	40,840													451.59	451.56
		.000034	20,520	2,010	10.2	.080	.50	10,260	11,440	565	20.3	.024	2.68	30,700		
760	40,700													452.88	
		.000026	11,630	1,343	8.6	.080	.395	4,590	15,040	710	21.2	.024	2.40	36,100		
781	40,500													453.43	
		.000031	21,190	2,225	9.5	.080	.462	9,800	12,125	610	19.9	.024	2.53	30,650		
790	40,300													453.70	
		.000029	3,200	360	8.8	.080	.423	1,350	15,130	730	20.7	.024	2.52	37,800		
Pekin. 807+350	39,000													454.20	454.07
		.0000320	32,390	2,725	11.9	.120	.36	11,600	11,020	530	20.65	.024	2.48	27,300		
820	38,900													454.61	
		.0000335	43,793	5,030	8.7	.120	.295	12,950	10,540	550	19.2	.024	2.45	25,600		
P. & P. U. R. R. bridge. 847+968	38,700													455.56	
		.000055	1,687	220	7.65	.120	.35	590	12,738	720	17.65	.024	2.95	37,700		
Peoria. 856+750	38,300													456.02	456.22

TABLE NO. 23—ILLINOIS RIVER FLOOD CREST OF APRIL, 1927. DISCHARGE RATES FOR PRINCIPAL GAGING STATIONS AND REACHES, LA SALLE TO PEORIA.

Gage.	Stations of 1,000 feet from Grafton.	Date.	Observed W. S. elevation.	Increments of tributary discharge.	Discharge. Computed by inflow.	Discharge. Computed by rating diagrams and curves.
				Illinois River at Morris, April 22 (U. S. G. S.), 3,800; Vermilion River at Streator, April 22-23 (U. S. G. S.), 7,400; Fox River at Dayton, April 22-23 (U. S. G. S.), 4,000.		
LaSalle	1,185+600	Apr. 23	463.88		49,400	
Peru	1,174+500	Apr. 23	462.70		49,400	
				No increase. Average c.f.s. per sq. mi. Spoon, Mackinaw, Fox and Vermion Rivers = 4.5. Tributary area LaSalle to DePue, 490 miles at 4.5= 2,000.		
DePue	1,130	Apr. 23	462.15		51,400	
				Area DePue to Hennepin, 200 sq. mi. at 4.5= 900.		
Hennepin	1,095+072	Apr. 23	461.70		52,300	
				Area Hennepin to Henry, 310 sq. mi. at 4.5= 1,400.		
Henry	1,035+408	Apr. 24	{461.69 461.44		53,700	
				Area Henry to Chillicothe, 400 sq. mi. at 4.5= 1,800.		
Chillicothe	960+300	Apr. 24	460.77		55,500	
				Area Chillicothe to Peoria, 250 sq. mi. at 4.5= 1,100.		
Peoria	856+750	Apr. 24	460.22		56,600	
Discharge by diagram						56,600
Discharge by U. S. Eng. curves						64,000
Discharge by U. S. G. S. curves						55,000

TABLE NO. 24—COMPUTED PROFILE FLOOD CREST APRIL, 1927, PEORIA TO LA SALLE.

Station.	Total discharge "Q."	Slope= fall÷ distance.	Over-bank section.						Channel section.						Computed W. S. elevation.	Observed W. S. elevation.
			Area.	P	R	n	v	Q	Area.	P	R	n	v	Q		
Peoria. 856+750	56,600	------------													460.22	460.22
	56,400	.0000043	50,970	3,070	16.6	.080	0.25	12,750	40,280	1,520	26.4	.025	1.08	43,500		
877															460.31	------------
	56,300	.0000140	33,840	3,870	8.75	.080	0.295	9,970	24,010	945	25.4	.025	1.93	46,400		
882															460.38	------------
	56,100	.00000175	103,040	6,160	16.75	.080	0.158	16,300	58,460	2,205	25.8	.025	.68	39,700		
908															460.43	------------
	55,800	.0000024	96,870	6,500	14.9	.080	0.172	16,650	50,633	2,070	24.4	.025	.77	39,000		
948															460.53	------------
	55,500	.000015	18,000	1,175	15.3	.080	0.44	7,900	22,580	830	27.2	.025	2.10	47,500		
Chillicothe. 960+300															460.73	460.77
	54,400	.0000076	80,178	6,400	12.5	.120	0.18	14,400	25,945	900	28.9	.025	1.53	39,750		
Lacon. 998+700															460.96	460.99
1,005															461.06	
	53,700	.0000078	89,950	5,720	15.7	.120	0.213	19,200	23,206	855	27.1	.025	1.48	34,300		
Henry Dam. 1,035+408															{461.29 461.54	461.44 461.69
	53,000	.0000052	116,000	7,420	15.6	.080	0.26	30,200	19,806	820	24.2	.025	1.14	22,600		
1,069															461.72	
	52,300	.0000040	161,280	11,580	13.9	.080	0.21	33,900	18,620	770	24.2	.025	.99	18,400		
Hennepin. 1,095+072															461.82	461.70
	51,400	.0000078	94,236	8,330	11.3	.080	0.26	24,500	19,100	770	24.9	.025	1.40	26,300		
DePue. 1,130															462.11	462.15
	50,400	.000015	46,530	4,225	11.0	.080	0.335	16,500	17,910	760	23.6	.025	1.90	34,000		
1,162															462.59	
Peru. 1,174+500																
	49,400	.000025	47,968	4,630	10.3	.080	0.44	21,100	12,070	540	22.6	.025	2.35	28,400	462.90	462.90
LaSalle. 1,185+600															463.18	463.88

TABLE NO. 25—TYPICAL VALUES OF COEFFICIENT "n" FOR MANNING FORMULA AND KUTTERS FORMULA FOR CREST FLOOD DISCHARGES OF ILLINOIS RIVER, APRIL, 1926—ALL LEVEES HOLDING.

Station 1,000 ft.	Total discharge "Q."	Slope= fall÷ distance.	Over-bank section.						Channel section.					
			Area.	R	Manning n	Kutter n	v	Q	Area.	R	Manning n	Kutter n	v	Q
50 80	60,850 60,850	.000058	17,260	3.20	.110	.108	.22	3,800	17,562	18.9	.0245	.028	3.26	57,200
201 227+750	60,100 59,930	.0000435	5,000	4.15	.110	.112	.225	1,120	21,560	17.5	.024	.028	2.75	59,300
299 325+250	59,750 59,660	.000058	6,960	5.5	.110	.125	.32	2,230	16,260	20.8	.024	.027	3.55	57,700
409+750 425	58,220 57,880	.000038	36,000	9.3	.100	.126	.40	14,400	16,150	19.2	.024	.029	2.73	44,100
493 526	50,060 43,700	.0000072	158,100	7.55	.080	.108	.186	29,400	13,075	19.3	.024	.040	1.17	15,300
526 542	43,700 43,600	.0000096	126,200	7.35	.080	.106	.212	26,750	11,670	21.9	.024	.038	1.47	17,150
589+776 613	43,350 43,350	.0000220	52,520	7.40	.080	.105	.325	17,100	13,400	17.8	.024	.032	1.97	26,400

profile agrees very closely with the observed stages at all gaging stations between Peoria and Peru. At the LaSalle highway bridge the observed stage was 0.7 foot higher than the computed stage, which discrepancy may be accounted for by the enlargement of the valley immediately below the highway bridge and the obstructions offered by railway and highway embankments opposite LaSalle, for which adjustments in the computations have not been made.

CONCLUSIONS ON VALUE OF "n" FOR MANNING FORMULA FOR ILLINOIS RIVER.

Based on the studies made, we have reached the conclusion that the value of "n" as used in the Manning Formula for flood crest discharges in the Illinois River channel from Grafton to LaSalle is practically constant. The coefficient "n" for the overflow section is modified by varying conditions of vegetation and topography. We have concluded also that for practical results the values should be such that a computed profile based on observed discharges will agree substantially with the observed stages when there are no levee breaks or other disturbances of channel or storage areas.

COMPARISON OF VALUE OF "n" FOR MANNING FORMULA AND KUTTER FORMULA.

For flood crest discharges on the Illinois River the values of "n" have been determined, as above described, for the flood of April, 1926, with all levees holding. Typical values of the coefficient "n" for the Kutter Formula for the same flood, thru a number of reaches, representing the range of slope and the range of hydraulic radius, have also been computed and the two values, together with the data upon which they are based, are shown in Table No. 25 which follows:

For the channel section the Manning "n" is constant at .024, except for the first reach where it would have made very little difference in the computed profile if the same value had been used—in the over-bank reach the value of "n" in the Manning Formula ranges from .080 to .110. For the channel section the value of Kutter's "n" ranges from .027 to .040, the smaller values are in the reaches where the slopes are the steepest, and the larger values are in the reaches where the slopes are flatter. In the over-bank section the value of Kutter's "n" ranges from .105 to .125—where the hydraulic radius is small Kutter's "n" approximates the value of Manning's "n" and the greatest variation between the two is where the slope is the least and the hydraulic radius is the largest. The hydraulic radius in the channel section ranges from about 18 feet to 21 feet and in the over-bank section from about 3 feet to 9 feet.

The foregoing illustrations merely indicate the greater uniformity of the derived value of the coefficient "n" for the Manning Formula as compared with that for the Kutter's Formula, when applied to the flood crest slopes and discharges for the lower Illinois River.

FLOOD CREST DISCHARGE PROFILES AND BACKWATER PROFILES.

Flood crest discharge profiles and backwater profiles have been prepared by applying the values for "n" shown in Tables No. 22 and 24, using the method developed by H. R. Leach, Principal Assistant to Robert E. Horton, Hydraulic Engineer, described in Engineering News Record, Vol. 82, page 768. Discharge Capacity Curves for crest profile slopes have been platted for each reach of the river between Grafton and LaSalle.

This method is applied by first dividing the total length of channel under consideration into reaches, each of which can be represented by a typical or average cross-section at the center of the reach, and then computing the fall required to carry given discharges thru the reach at any stage.

The Manning Formula is as follows:

(1) $Q = A \times \frac{1.486}{n} \times R^{2/3} \times S^{1/2}$ in which

$Q =$ Discharge in cu. ft. per sec.
$A =$ Area of cross section in sq. ft.
$n =$ Coefficient.
$R =$ Hydraulic Radius $= \frac{\text{Area}}{\text{Wetted Perimeter}}$
$S =$ Slope $= \frac{\text{Fall}}{\text{Length}}$ in feet.

With a given cross-section the term $A \times \frac{1.486}{n} \times R^{2/3}$ is constant and calling this factor Kd and substituting we have (2) $Q = Kd\ S^{1/2}$ Using the weighted average cross-section at the middle of the reach, the value of the factor Kd for overflow and channel areas can be determined separately, and combined for the total Kd value for any water surface elevation at center of reach, and a table or curve made for each reach showing the Kd values for various stages. With the discharge and stage at the center of reach given, the slope is immediately determined by equation (2) and assuming the stage at the center of reach at once fixes the fall required for any given discharge, as well as the elevation of water surface at the head and foot of the reach. From this it follows that for a given discharge there is a definite relation between the stage at the foot of the reach and at the head of the reach for any assumed stage at the center of the reach. This relation can be shown by a curve for any discharge, the abscissa being the elevation at foot of reach and the ordinates the elevation at head of reach. Such a curve will be asymptotic to a straight line drawn through points of equal elevation, as with increasing depth the slope or fall thru the reach approaches zero. In this manner with any assumed discharge a curve can be drawn for each reach showing the stage relation, and since the head of any reach is the foot of the adjoining upstream reach, it follows that assuming the stage in a given reach at once fixes the stage in all other reaches above and so determines the water surface profile for the discharge assumed.

This method can be extended and a series of curves constructed for each reach, with a series of discharge quantities selected covering the desired range, from which by interpolation all possible profiles can be accurately determined without resort to the usual trial and error methods. The method is as follows: plot the curves of discharge and stage relation of the first reach with the stage at foot of reach on the horizontal axis and the stage at head of reach on the vertical axis. As the stage at head of Reach No. 1 is identical with the stage at foot of Reach No. 2 the axes for discharge and stage relation curves for Reach No. 2 can be reversed and the stage at foot of reach platted on the vertical axis and the stage at head of reach platted on the horizontal axis. Thus the stage at the junction of the two reaches may be read on the same ordinate on either curve. The same reasoning applies to all other reaches, and by alternating the axis in the above manner a series of discharge stage relation curves for reaches in pairs alternating on either side of the zero lines are obtained.

Any initial stage and discharge at the foot of Reach No. 1 may be assumed and by tracing through the curves from the initial stage at foot of reach to the intersection of this ordinate with the discharge selected, the stage at head of reach is determined on its corresponding scale; proceeding on this scale to an intersection with the desired discharge in Reach No. 2, the stage at head of Reach No. 2 is determined on its corresponding scale. This process can be repeated from one reach to the adjoining upstream reach and the elevation of water surface at the head of each reach tabulated for use in platting the profile.

An illustration of typical discharge and stage relation curves and method of using them are shown on Figure No. 35. For purpose of comparison, by use of the discharge and stage relation curves, elevations were computed for profiles for the flood crests of April 1920, April 1922 and April 1927 from Grafton to Peoria. For each of these floods a table of discharges was made, using the rating diagrams as a basis and building up discharges from one gaging station to another downstream by the addition of increments from the tributary streams and areas based on U. S. Geological Survey Discharge Tables.

Table No. 26 shows the magnitude of discharge determined by the above method at each gaging station, the computed stage elevation at each gaging station determined from discharge and stage relation curves, and the corresponding observed stage elevation. The computed profiles and observed profiles for the flood crests April 1920, April 1926 and April 1927, are shown on Figure No. 36 of this report.

The profiles for the observed and computed high water of April 1926 from Grafton to Peoria, and April 1927, from Peoria to LaSalle are used for the determination of the coefficient of roughness "n." These profiles show how closely the observed profile is followed by the computed profile, using the value of "n" as herein determined for the back-water computation. The computed profile for the high water of 1920 is higher than the observed profile for that year, and reflects the effect of the construction of additional levees in the Illinois Valley, particularly between Havana and Pekin where the Chautauqua Districts and the East Liver-

TABLE NO. 26—COMPARISON OF OBSERVED AND COMPUTED STAGES FLOOD CRESTS APRIL 1920, APRIL 1922 AND APRIL 1927.

Gage station.	Miles from Grafton.	Flood crest, April 1920.			Flood crest, April 1922.			Flood crest, April 1927.		
		Observed stages.	Discharge c.f.s.	Computed stages.	Observed stages.	Discharge c.f.s.	Computed stages.	Observed stages.	Discharge c.f.s.	Computed stages.
Grafton	0	432.20	75,000	432.20	436.79	97,000	436.79	434.74	96,600	434.74
Hardin	21.8	----------	73,700	----------	----------	95,800	----------	----------	96,300	----------
Kampsville	31.4	437.00			441.05		441.27	440.20		440.20
	31.5	437.13	72,600	437.41	441.18	85,800	441.40	440.33	96,000	440.33
Pearl	43.2	438.75	71,700	439.44	442.70	80,900	442.96	442.30	95,800	442.55
Valley City	61.6	443.65	71,000	443.74	447.38	80,600	446.50	447.52	94,800	447.33
LaGrange	77.5	445.60			449.38		448.70	449.33		449.87
	77.6	445.76	69,300	446.32	449.43	80,200	448.75	449.38	92,300	449.93
Beardstown	88.8	448.55	66,700	448.95	452.23	79,200	451.27	452.45	87,800	452.66
Bath	111.7	449.73	59,700	450.30	453.01	60,700	452.23	453.26	68,800	453.59
Havana	119.9	451.23	54,900	451.63	454.33	60,500	453.33	453.93	68,600	454.72
Liverpool	128.0	451.80	51,500	453.33	454.90	58,000	454.85	454.70	63,000	456.22
Copperas Creek	136.7	452.38	51,200	454.02	455.23	57,800	455.50	455.08	62,300	456.90
Pekin	152.9	456.62	48,700	456.64	459.17	53,600	458.22	458.07	58,000	459.45
Peoria	162.3	458.72	47,800	458.22	460.52	52,500	459.62	460.22	56,800	460.75

TABLE NO. 27—BACKWATER ELEVATIONS ILLINOIS RIVER FOR CREST OF FLOOD STAGES WITH MISSISSIPPI RIVER AT GRAFTON CRESTIN SIMULTANEOUSLY WITH NORMAL ILLINOIS RIVER FLOOD CREST.

Reach No.	Station.	Location.	Discharge in C. F. S.												
			50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000	130,000	140,000	150,000	160,000	170,000
	0		424.88	426.70	428.40	429.90	431.20	432.30	433.40	434.50	435.50	436.50	437.50	438.45	439.35
		Marshall Landing.													
1	50		426.97	428.67	430.34	431.79	433.11	434.22	435.33	436.38	437.34	438.37	439.36	440.27	441.17
		Coon Creek Landing.													
2	80		428.27	429.97	431.62	433.02	434.33	435.45	436.58	437.58	438.57	439.58	440.52	441.40	442.32
		Hardin.													
3	124		430.31	432.07	433.80	435.18	436.59	437.83	439.05	440.13	441.17	442.22	443.21	444.10	445.02
		Keaches Landing.													
4	166 *	Kampsville.	431.88	433.68	435.46	436.88	438.25	439.57	440.83	441.93	442.99	444.08	445.11	446.02	446.97
		Kampsville.													
5	201		433.28	435.14	436.90	438.35	439.76	441.10	442.40	443.53	444.62	445.73	446.78	447.72	448.70
		Pearl.													
6	227+750	Pearl.	434.40	436.23	437.98	439.45	440.85	442.20	443.51	444.67	445.77	446.86	447.93	448.87	449.86
		Buck Horn Landing.													
7	264		436.30	438.13	439.88	441.40	442.82	444.18	445.48	446.67	447.79	448.93	450.03	450.99	451.98
		Florence Landing													
8	299		437.85	439.78	441.57	443.15	444.62	446.01	447.32	448.57	449.73	450.93	452.08	453.06	454.10
		Griggsville Landing.													
9	325+250	Valley City	439.10	441.08	442.90	444.53	446.05	447.47	448.80	450.10	451.34	452.58	453.75	454.77	455.83
		Earle's Ferry.													
10	354		440.45	442.43	444.24	445.88	447.43	448.90	450.23	451.52	452.80	454.10	455.23	456.28	457.38
		Meredosia Island.													
11	376	Meredosia.	441.16	443.14	444.98	446.62	448.18	449.66	451.00	452.32	453.61	454.91	456.05	457.12	458.17
		Eagle Island.													
12	397		441.65	443.60	445.43	447.04	448.63	450.09	451.44	452.75	454.03	455.33	456.45	457.50	--------
		LaGrange Lock.	441.87L	443.82L	445.64L	447.24L									
13	409+750	LaGrange.	442.02U	443.94U	445.72U	447.29U	448.83	450.27	451.63	452.93	454.23	455.53	456.64	457.69	--------
		LaGrange Landing.													
14	425		442.73	444.60	446.35	447.91	449.46	450.85	452.22	453.50	454.78	456.08	457.20	458.27	--------
		Reich's Landing.													
15	442		443.72	445.65	447.43	449.04	450.62	452.08	453.46	454.77	456.08	457.40	458.55	459.65	--------
		Briggs Landing.													
16	452		444.15	446.07	447.88	449.51	451.10	452.58	453.94	455.21	456.57	457.88	459.06	460.10	--------
		Crape Island.													
17	462		444.63	446.58	448.37	450.01	451.62	453.11	454.48	455.76	457.07	458.39	459.61	460.68	--------
		Beardstown.													

TABLE NO. 27—Continued.

Reach No.	Station.	Location.	Discharge in C. F. S.												
			40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000	130,000	140,000	150,000	160,000
18	469	Beardstown. Beardstown.	--------	444.88	446.86	448.65	450.28	451.92	453.40	454.80	456.07	457.37	458.70	459.94	461.03
19	493	Fredrich.	--------	445.14	447.10	448.88	450.52	452.15	453.62	455.00	456.27	457.52	458.88	460.10	--------
20	512+500 526	Browning.	--------	445.61	447.47	449.18	450.76	452.35	453.82	455.18	456.45	457.68	459.05	460.26	--------
21	542	Butlersville.	--------	445.92	447.70	449.48	450.93	452.50	453.93	455.30	456.57	457.83	459.18	--------	--------
22	572	Bluff City.	--------	446.75	448.45	450.15	451.58	453.08	454.45	455.79	457.07	458.30	459.62	--------	--------
23	590	Anderson Lake. Bath.	--------	447.05	448.71	450.37	451.79	453.30	454.66	455.98	457.25	458.48	459.80	--------	--------
24	613	West Mantanza Lake	--------	447.80	449.38	451.05	452.40	453.87	455.21	456.55	457.78	458.98	--------	--------	--------
25	633+300	Phelps Lake. Havana.	--------	449.03	450.63	452.32	453.73	455.24	456.57	458.00	459.18	460.40	--------	--------	--------
26	655	Havana.	--------	449.72	451.36	453.03	454.47	456.00	457.33	458.74	459.93	--------	--------	--------	--------
27	676	Liverpool. Liverpool.	--------	451.18	452.96	454.70	456.25	457.83	459.26	460.67	--------	--------	--------	--------	--------
28	707	Clear Lake.	--------	451.91	453.71	455.46	457.04	458.63	460.01	461.47	--------	--------	--------	--------	--------
29	722	Senate Island. Copperas Creek.	450.20	452.15	453.94	455.70	457.27	458.84	460.25	--------	--------	--------	--------	--------	--------
30	760	Copperas Creek	451.75	453.78	455.64	457.46	459.12	460.66	462.07	--------	--------	--------	--------	--------	--------
31	766+675 781	Kingston Mines.	452.45	454.50	456.42	458.25	459.98	461.52	462.93	--------	--------	--------	--------	--------	--------
32	790	Mapleton.	452.76	454.85	456.78	458.63	460.35	461.88	463.29	--------	--------	--------	--------	--------	--------
33	807+350	Pekin Landing. Pekin, Ill.	453.35	455.52	457.48	459.37	461.17	462.75	464.20	--------	--------	--------	--------	--------	--------
34	820	Pekin.	453.81	456.03	457.98	459.88	461.67	463.25	464.74	--------	--------	--------	--------	--------	--------
35	848	Wesley City (now) Creve Coeur.	454.84	457.05	458.93	460.67	462.40	464.00	465.56	--------	--------	--------	--------	--------	--------
36	856+750	Peoria. Peoria, Ill.	455.28	457.52	459.42	461.18	462.95	464.53	466.14	--------	--------	--------	--------	--------	--------

TABLE NO. 27—Concluded.

Reach No.	Station.	Location.	Discharge in C. F. S.						
			30,000	40,000	50,000	60,000	70,000	80,000	90,000
		Averyville.							
37	877		453.22	455.38	457.65	459.53	461.30	463.09	464.68
		Peoria Heights.							
38	882		453.29	455.47	457.76	459.64	461.47	463.20	464.79
		Mossville.							
39	908		453.32	455.50	457.81	459.70	461.52	463.27	464.87
		Rome.							
40	948		453.42	455.62	457.95	459.84	461.67	463.42	465.02
		Chillicothe.							
	960+400	Chillicothe.							
41	961		453.57	455.82	458.17	460.10	461.95	463.69	465.27
		Lacon.							
42	1005		453.90	456.24	458.59	460.61	462.42	464.12	465.62
		Henry.							
43	1034+900		{454.15L 454.40U	456.52L 456.72U	458.88L 459.03U	460.90L 461.00U	462.72L 462.77U	464.44L U	465.96L U
		Swan Lake.							
44	1069		454.64	456.97	459.32	461.27	463.03	464.72	466.15
		Hennepin Lake.							
45	1093								
	1096+100		454.79	457.11	459.48	461.43	463.17	464.85	466.28
		Hennepin.							
46	1130		455.27	457.58	459.92	461.88	463.58	465.25	466.68
		Spring Valley.							
47	1162		455.98	458.33	460.65	462.64	464.30	465.97	467.38
		Peru-LaSalle.							
48	1185+400	LaSalle.	456.93	459.29	461.54	463.47	465.12	466.82	468.20

* NOTE.—No correction made for drop at Kampsville dam.

pool District were not completed in 1920. The computed profile for the April 1927 high water is slightly higher than the observed from Kampsville to Bath, and from Bath to Peoria is considerably higher. A number of levee districts were open and receiving storage between Kampsville and Bath. Between Bath and Peoria the water was flowing thru the Chautauqua District and East Liverpool District, and the profiles show clearly the effect on flood stage of closing the levees in these districts.

Back-water flood crest discharge elevations for profiles were computed using the discharge stage relation curves shown as typical discharge on Figure No. 37, as above described, for discharges of—

50,000 to 170,000 from Grafton to Meredosia.
50,000 to 160,000 from Meredosia to Beardstown.
50,000 to 140,000 from Beardstown to Bath.
50,000 to 130,000 from Bath to Havana.
50,000 to 120,000 from Havana to Copperas Creek.
40,000 to 100,000 from Copperas Creek to Peoria.
30,000 to 90,000 from Peoria to LaSalle.

All of the above elevations were computed from a normal flood stage in the Mississippi River corresponding to a normal flood crest in the Illinois River, without apparent back-water effect, and are shown for the end of each reach in Table No. 27.

On Figure No. 37 "Normal Flood Crest Profiles" are also shown back-water flood crest profiles, as follows:

1. The computed October 1926 flood crest discharge entering the Mississippi River at the elevation of October 1926 high water, with all levees holding.

2. The computed October 1926 flood crest discharge entering the Mississippi River at the elevation of the 1844 high water, with all levees holding.

3. For a discharge 20,000 c. f s. greater than the computed October 1926 flood crest entering the Mississippi River at the 1844 high water, with all levees holding.

The flood stage of 1844 was higher at LaSalle than the back-water computations for the maximum flood as computed for present levees. The valley from Peoria to LaSalle has a much greater carrying capacity than in 1844, due to the deadening of timber and better flowage conditions.

COMPARISON OF DISCHARGE RATING CURVES AND DIAGRAMS—PEORIA—HAVANA—BEARDSTOWN—PEARL.

The discharge rating curves made by the U. S. Engineers, and discharge rating curves made by the U. S. Geological Survey at Peoria, Havana and Beardstown from discharge measurements made by them, respectively, since 1920 are shown on Figures, Nos. 38 and 39, with the discharge rating diagrams developed in the study for this report. These discharge rating diagrams are based upon the discharge computations for discharge, stage and slope at those stations, with all levees now constructed sufficiently high and holding. At Beardstown the rating

curves of the U. S. Engineers, the U. S. Geological Survey and our computed normal rating curve for flood crest, are in substantial agreement up to elevation 452, which is about a 25-foot stage on the Beardstown gage. Above that stage the U. S. Engineers and U. S. Geological Survey have no discharge measurements and their curves if projected would show discharges much in excess of the discharges by the flood crest normal rating curve with all levees holding. The rating diagram and normal rating curve for Pearl are those developed in the study for this report. At Havana there is a very marked divergence between the U. S. Engineers, the U. S. Geological Survey and our flood crest normal rating curves. This is evidently due to the fact that the flow passing Havana at the time the discharge measurements were made was greatly modified by the Spoon River in-flow and levee breaks, as all high stage discharge measurements were made either in 1922, 1926 or 1927. At Peoria the U. S. Engineers rating curve and our flood crest normal rating curve are in close agreement, but the U. S. Geological Survey discharge rating curve shows a much lower rate of discharge. The disagreement in these rating curves is doubtless due in large part to the levees breaking and the modification of the fall from Peoria to Pekin resulting therefrom. The flood crest normal rating curves and the flood crest slope discharge diagrams shown on these two figures (Nos. 38 and 39) are developed from the normal flood crest back-water profiles shown on Figure No. 37 in this report.

MAXIMUM FLOOD DISCHARGES.

The flood of October 1926, represents the maximum inflow entering the Illinois Valley at Beardstown of which we have any definite record. The flood of 1904 probably represents the greatest inflow at Peoria. There is practically no information regarding the flood of 1844, except the high water profile determined from high water marks identified by the U. S. Engineers in their survey (1902 to 1904) for the report on the 14-foot Waterway, H. D. 263, Fifty-ninth Congress, First Session. The earlier reports of the surveys and investigations of the Illinois River show that the overflowed valley lands were covered with a dense growth of timber and vines. A large part of the timber and brush which was growing in the lower Illinois Valley, especially above Beardstown, has been killed by the higher Summer river stages which have prevailed since the opening of the Chicago Sanitary and Ship Canal. The flood carrying capacity of the overflowed area has been increased from 10 per cent to 20 per cent by deadening of the timber and brush, previously growing on large areas or overflowed land. Alvord and Burdick estimated the flood discharge of 1844 as 10 per cent greater than that of 1904 at Peoria.

The recent studies of the flood carrying capacity of the Illinois Valley, taking into account the conditions of vegetation, and the fact that for the very flat slopes which exist between Peoria and LaSalle the capacity computed by Kutters Formula is greater than that computed by Mannings Formula, we have reached the conclusion that the maximum

discharge at Peoria for the 1904 flood did not exceed 75,000 c. f. s. and probably was nearer 70,000 c. f. s. These conclusions are supported by the following:

1. The discharge rating curve for Peoria, based upon measurements made by the author of this report in 1900, indicate a discharge for the 1904 flood stage of 75,000 c. f. s.

2. A back-water computation from Peoria to Peru, using the factors that apply to the present condition of the channel and overflowed area with 75,000 c. f. s. at Peoria, and a reduction in the quantity up-stream for inflow of tributaries, produced a profile which corresponds almost precisely with the high water profile of 1904.

3. A back-water computation for 90,000 c. f. s., with corresponding reductions as we proceed up-stream and starting from Peoria at the stage of 1904 high water, produced a high water profile which is 0.8 foot above the observed stage of 1904 at Henry—no available gage readings at Peru. We have not been able to get the back-water computations from Peru to LaSalle to check against the observed slopes, due no doubt to unknown obstructions and factors of the area of the channel and overflow.

4. A considerable portion of the overflowed area in the valley between Peoria and Peru was covered in 1904 with a dense growth of timber which is now dead and has disappeared.

The estimated flood discharge for the October 1926 flood, upon which back-water computations have been based, assuming that all existing levees were holding, is as follows:

Grafton to Kampsville	120,000 c. f. s.
Kampsville to Pearl	117,000 c. f. s.
Pearl to Crooked Creek	115,000 c. f. s.
Crooked Creek to Beardstown	110,000 c. f. s.
Beardstown to Havana	72,000 c. f. s.
Havana to Pekin	66,000 c. f. s.
Pekin to Peoria	60,000 c. f. s.
Peoria to Chillicothe	59,000 c. f. s.
Chillicothe to Henry	58,000 c. f. s.
Henry to Hennepin	56,000 c. f. s.
Hennepin to LaSalle	55,000 c. f. s.

The October 1926 flood represents a discharge at Peoria of 59,000 c. f. s., which is about 10,000 less than our present estimated flood discharge of 1904. In 1926 the Sangamon River at flood-crest is estimated to have been delivering 38,000 c. f. s. at Beardstown, but the Alvord and Burdick estimates of the Sangamon contribution to the maximum discharge of the 1904 flood is 15,000 c. f. s. From a consideration of all the conditions of the tributaries and their possible contributions to the flood stage at crest, we have reached the conclusion that the maximum flood discharge, with all levees holding, from Beardstown to Grafton, may be 20,000 c. f. s. in excess of the estimated discharge of 1926. We have also reached the conclusion that the maximum discharge from Beardstown to LaSalle may be as much as 20,000 c. f. s. in excess of that of 1926. In other words, the flood discharge as estimated for 1926 may be exceeded thruout the entire length of the lower river by 20,000 c. f. s. additional. This would represent an average discharge of about 30 per

cent in excess of that of 1926 for the river above Beardstown, and about 18 per cent in excess of that of 1926 below Beardstown.

FLOOD FLOW OVER VALLEY LAND.

Before levees were built a very large portion of the flow of major floods passed down-stream over the wide valley. Between Beardstown and Hardin the valley was from two to four miles wide and more than 95 per cent of this area has been leveed. Approximately 50 per cent of the discharge of a major flood at crest passed over the valley. Similar conditions prevail between Pekin and Havana, where about 75 per cent of the land has been leveed. With levees holding the water must rise high enough in the channel and over the remaining narrow floodway between the river channel and the levees or foothills to compensate for this reduced floodway area.

CLEARED FLOODWAYS.

All reports upon the floods of the Illinois River, which refer to the carrying capacity of the channel, refer to the effect of timber, brush and other vegetation upon the water carrying capacity of the overflowed area. In general terms it has been found that a river channel which is free from vegetation has a carrying capacity of from two to six times as much as a floodway of equal depth and width grown up with grass, weeds, brush or timber. The ratio of the carrying capacity of a floodway to that of a clear channel depends upon the relative density of the vegetation. Many estimates have been made for the carrying capacity of a floodway clear of vegetation and kept as a cleared floodway at flood time. The greater number of floods occur in the Spring months, but the most disastrous flood on the Illinois River occurred in October when all timber and brush growth were covered with leaves, and weeds and grass and were of maximum proportions, literally cutting off at the beginning of the flood, and in many instances until the flood crest had actually passed, from one-half to three-fourths of the carrying capacity of the overflowed or floodway areas.

The great expense which would be incurred from year to year to maintain effectively cleared floodways for carrying floods occurring at irregular intervals has not been accomplished and probably will not be readily provided for by drainage districts, because of the apparent wasting of money thus expended covering many years when no large floods occurs. The land-owners in the levee districts are hard pressed with taxes and are properly jealous of unnecessary expenditures, and maintaining a cleared floodway does and would appear, to them, to be unwarranted. Long years of contact and experience in maintaining levees leads to the conclusion that it is not safe to anticipate that floodways will be maintained clear of timber, except in specially favored areas where the land in the floodway is overflowed so seldom that it can be cultivated at a profit. Under the control of the State, or a political sub-division of the State covering the entire valley, charged with the responsibility, floodways might be maintained in much more efficient condition. For the low lands alternate flooding and draining might be provided for so

that during the early part of the season the land might be flooded and prevent the growth of land plants, and drained during the latter part of the season when the land plants would not naturally thrive, but during which time the aquatic plant growth would perish.

The two methods above mentioned might be combined in such a manner as to give a very much larger efficiency to the floodways at little cost, but keeping the vegetation down by seasonal cutting as the only other alternative must not be relied upon.

In view of these conditions the carrying capacity of any floodway must usually be predicated upon the condition and growth of vegetation which nature will produce.

SILT ACCUMULATION IN THE FLOODWAY.

The tributary streams all carry a considerable amount of silt, a large part of which is deposited along the banks of the channels and on the land overflowed where the water from the tributaries enters the Illinois River. This process of building up the banks is continuous. Where the smaller tributaries enter the valley there is a perceptible filling of considerable magnitude, but the major portion of the silt brought down by these streams is deposited soon after it enters the valley and only a very small part is deposited along the main stream. The silting problem is, therefore, primarily of local interest to the land adjacent to the outlets of the smaller streams and the valley immediately near the foot-hills. The capacity of the floodway for the main stream will not be vitally affected by sediment.

DAMAGES TO FLOODED DISTRICTS.

About one-half of the leveed area was flooded in 1926 and the damage to crops and property for this one overflow has been estimated at $6,000,000 which is more than enough to pay for the cost of raising the levees as much as the increased stage would have been. The damages due to the interference with the program of farming by flooding, such as when a levee breaks with the overflow continuing for several months (and, as in 1926 and 1927, an average of more than a year), cannot be fully measured by the destruction of crops, the cost of repairing broken levees, cleaning out ditches, repairing and restoring buildings and roads, but includes also an indeterminable depreciation, due to the discouragement of those who are using or would use the lands. It is practically certain that owners and tenants would not willingly subject themselves to the hazard in levee districts which are to be used for emergency flood crest storage, and that they would abandon the land if such a program were to be carried out, unless very definite arrangements were provided by the State for full compensation for damages in case of flooding.

In view of the increasing demand for fish and game preserves along the Illinois River, it might become a profitable enterprise to convert some of the existing levee districts, or to construct levees around some of the remaining open areas to be used for flood crest storage without great damage to the property as fish and game preserves. It would doubtless

be necessary for the State, or some agency to be created by the State, to take over these lands and provide the necessary funds for their maintenance, because it is not probable that private enterprise could be relied upon to carry on a development of this kind which would be effective for flood control purposes.

FLOOD CONTROL METHODS.

The low lands in the Illinois River Valley may be protected from floods by two general methods:

First—Improvement of the River Channel.

Second—Storage of flood water:

1. Improvement of the river channel may include:
   (1) Raising the levee heights.
   (2) Excavation of channel.
   (3) Widening of floodway by setting levees back.
   (4) Keeping the overflowed area free of vegetation that would obstruct the flow.
2. Storage may be provided by:
   (1) Reservoirs or detention basins in the valleys of the tributary streams.
   (2) Storage areas in levee districts or behind levees specially constructed for flood crest storage in the Illinois Valley.
   (3) Control of the diversion of water from Lake Michigan during flood periods.

The construction of levees and increasing the levee heights to prevent overflow produces higher flood stages and subjects additional lands to overflow, thus extending the area menaced by floods. The other methods of flood control all tend to reduce the stages for any given flood flow, but some of them do not produce results in proportion to their cost. Channel excavation, while necessary and useful for low water navigation, is not a practicable method for increasing flood carrying capacity of streams of the magnitude of the Illinois River. Widening the floodway by setting levees back has been investigated and shows that a substantial lowering of the river can be accomplished from Pearl to LaSalle at a cost considerably less than the cost of raising levees sufficiently to take care of an equal flood-flow. Keeping the over-banks portion of the channel clear of vegetation has a much greater value than is generally recognized and, for the purpose of the estimates in this investigation, the areas which lie between the present levees and the proposed location for set-back levees, which is now under cultivation, is expected to be maintained free from timber, brush and growth of large annual weeds by cultivation, or by alternate flooding and drying, so as to give an effective carrying capacity of about double that of the ordinary over-flowed area with natural growth of vegetation.

Storage or detention basins on tributary streams to be effective for flood control in the Illinois River would require a large number of such reservoirs. This would necessitate the appropriation of valuable land, much of which is in a high state of cultivation in the valleys of the tribu-

tary streams and, under present conditions, cannot be relied upon for flood control in the Illinois River. With the increase of population on the Illinois watershed the municipal and industrial demands for water supply will require storage reservoirs on the tributaries, and these may be so designed as to serve the double purpose of providing water supply and flood control, which could be reflected in lower flood stages in the Illinois River.

Flood crest storage in the levee districts in the Illinois Valley may be used to hold down peak-flood stages. The effect of this storage is very well shown by the breaking of levees in the floods of 1922 and 1926. The computations show that if the levees had not broken in 1926 the river stage would have been higher through the central portion of the lower valley, as follows:

At Peoria	1.33 ft.	At Meredosia	2.56 ft.
At Copperas Creek	1.92 ft.	At Valley City	2.20 ft.
At Liverpool	1.93 ft.	At Pearl	2.89 ft.
At Havana	1.73 ft.	At Kampsville	1.97 ft.
At Beardstown	1.79 ft.		

DISCHARGE AND STORAGE RELATIONS.

The general equation for Discharge and Storage Relation is:

$$\text{Inflow} = \text{Outflow} + \text{Storage}$$

When a stream is rising the inflow is greater than the outflow by the amount of the storage represented by the rise, and when falling the inflow is less than the outflow by an amount represented by the fall. The area of the water surface, therefore, becomes a controlling factor in stream flow. As the flood crest proceeds down-stream the water is falling in the upper and rising in the lower reaches, and the problem of estimating discharge becomes further complicated when overflow storage areas and the floodway carrying capacity are both modified by levee building and by breaks in levees.

The effect of levees on the stage of the river is shown by the greater increase in stage in the central and lower portion of the valley where the overflow areas have been most reduced.

Discharge measurements along the main stream and of the tributaries from which reliable discharge and rating curves or diagrams may be made, daily or semi-daily river stages at control points, and accurate surveys of the river channel and overflow areas furnish the data needed.

The discharge measurements of the Illinois River made during the last thirty years disclose that its flood carrying capacity for any high water stage is much less than before levees were built.

It is necessary to know the inflow, the storage area available and the discharge capacity at the outfllow point for computing river stages based upon inflow, outflow and storage. Outflow points must be chosen where discharge rating curves or discharge rating diagrams are available. The river valley should be divided into reaches thru which the normal flood crest would pass within a one day period to simplify the storage computations. A working formula has been developed for computing the daily change in stage, without resorting to approximating the ratios of the inflow which would be accounted for as storage and discharge. The formula is as follows:

$$h = \frac{Q_s - Q_1}{A + \frac{1}{2}q} \text{ in which—}$$

h = the rise (or fall) in feet or stage for one day.

Q_s = the inflow in c. f. s. days for one day, or the average rate of inflow in c. f. s.

Q_1 = outflow in c. f. s. days for one day, at the rate of flow at the beginning of the day.

A = the total storage area in acres divided by 1.98 which is equivalent to c. f. s. days storage one foot deep.

q = the increase of discharge in c. f. s. for one foot of rise above the the stage at the beginning of the day, which is the rate of increase in discharge for stage at the beginning of the day.

The foregoing formula reduced to a rule would be as follows: From the total inflow for a day subtract an amount equal to the outflow for a day at the rate at the beginning of the day; divide the dierence by the sum of the storage for one foot of depth over the area plus one-half of the increase in discharge for one foot of rise at the stage at the beginning of the day; the quotient will be the increase or decrease in stage in feet.

Beginning at the up-stream outflow station and using inflow quantities during the progress of a flood, daily stage readings may be computed for any given condition of inflow and storage. Considering the outflow as the inflow of the next reach down stream and adding the tributary inflow, the stage may be computed for the next gaging station, and in this order develop profiles of daily stages.

By using discharge rating diagrams, which show stage-slope-discharge relations, adjustments may be made in the daily computed flood profiles based upon the inflow, outflow and storage equation.

Computations have been made for the stages that would have occurred at Beardstown and Havana in the October flood of 1926 if the levees had held, using the inflow, outflow and storage relations. From these computations the rate of discharge from day to day which would have occurred if the levees had held was determined. Back-water computations for flood crest profiles check closely the stage for 1926 flood, with all levees holding, that was found by the infiow and outflow computations.

FLOOD HEIGHTS REDUCED BY SET-BACK LEVEES.

The levees constructed on both banks of the Illinois River from Beardstown to Pearl are from 1,100 to 2,000 feet apart. The river stages at Beardstown and vicinity have been increased to a greater extent than at any other portion of the Illinois valley. Some method of reducing flood stages in this reach of the river and lessening the hazard of breaking levees is of greatest importance. A study has been made to determine to what extent the flood stages can be lowered by setting levees back wherever it is economically possible, thereby increasing the floodway carrying capacity. There are long lakes parallelling the river back of the levees in a number of these levee districts, and the plan for levee setbacks includes construction of new levees behind the lakes in these dis-

tricts, so as to get not only the benefit of widening, but also the depth for increasing the carrying capacity of the floodway thru levee set-backs. The studies disclose that the high water stages can be reduced, depending upon the magnitude of the flood, at Beardstown from two feet to nearly three feet, at Peoria about one and one-half feet., and at LaSalle about one foot, by setting the levees back thru a portion of the following districts, viz—Big Swan, Big Prairie, Scott County, South Beardstown, Valley City and Cole Creek, and leaving the Chautauqua District open. No estimates have been made for setting levees back below the Big Swan District, because the back-water from the Mississippi River is the controlling factor in levee heights from Grafton to the vicinity of Pearl, and the Big Swan District is the first that appears to offer an economical location for levee set-back. The position of the proposed set-back levees and the areas which would be included in the floodway are shown on map, Figure No. 40.

Computed high water profiles for flood stages, with all levees holding in their present positions, and also with the levees set-back, are shown on Figure No. 41. These profiles are computed for two flood quantities, viz—

1. Flood discharge equal to the flood of 1926 when confined between levees and entering the Mississippi River at the 1844 flood stage.
2. Flood discharge 20,000 c. f. s. greater than the flood discharge of 1926 entering the Mississippi River at the 1844 flood stage.

On this drawing, Figure No. 41, are shown the following profiles:

(1) Profile A represents the observed river stages for the October 1926 flood.

(2) Profile B_1 represents the computed flood crest profile for a discharge equal to that of October 1926, with all levees holding.

(3) Profile B_2 for the same conditions as B_1, except with the levees set back, as shown on Figure No. 40 and with the Chautauqua District open.

(4) Profile C_1 is for the same discharge as Profile B_1, entering the Mississippi River at the 1844 flood stage.

(5) Profile C_2 is for the same condition as C_1, except with the levees set back, as shown on Figure No. 40 and with the Chautauqua District open.

(6) Profile D_1 is for a discharge 20,000 c. f. s. greater than that of 1926, with all levees holding, entering the Mississippi River at the 1844 flood stage.

(7) Profile D_2 is for the same condition as D_1, except with levees set back, as shown on Figure No. 40 and with the Chautauqua District open.

All of the foregoing computations are based upon the existing levees holding and no other levees (except set-backs) constructed in the Illinois Valley.

Table No. 28 contains flood stage elevations for effect of setting levees back, as shown on profile, Figure No. 41.

TABLE NO. 28—FLOOD STAGES WITH AND WITHOUT LEVEES SET BACK.

Stations.		A	1926 discharge.	B_1	B_2	C_1	C_2	1926 discharge +20,000 c.f.s.	D_1	D_2
0	Grafton	434.60	120,000	434.70	434.70	443.10	443.10	140,000	443.10	443.10
50				436.52	436.52	443.73	443.73		443.95	443.95
80				437.70	437.70	444.19	444.19		444.54	444.54
124				440.20	440.20	445.40	445.40		446.08	446.08
166	Kampsville	439.90L 440.03U	120,000	442.00	442.00	446.37	446.37	140,000	447.33	447.33
201			117,000	443.50	443.50	447.27	447.27	137,000	448.45	448.45
227	Pearl	441.70	117,000	444.59	444.59	447.95	447.95	137,000	449.25	449.25
264			115,000	446.47		449.23		135,000	450.72	450.72
299				448.26		450.58			452.31	451.91
325	Valley City	447.50		449.70	448.70	451.73	450.80		453.65	452.32
354				451.10		452.85			454.92	452.77
376	Meredosia	449.29		451.85	450.50	453.47	452.37		455.61	453.63
397				452.27		453.83			455.96	454.07
409+	LaGrange	450.28L 450.33U		452.45	451.20	453.97	452.87		456.12	454.27
425				453.03		454.45			456.59	454.87
442			115,000	454.16		455.43		135,000	457.67	455.41
452			110,000	454.61		455.82		130,000	458.10	455.72
462				455.10		456.25			458.53	455.95
469+	Beardstown	453.61	110,000	455.40	453.10	456.50	454.50	130,000	458.80	456.13
493			72,000	455.47		456.57		92,000	458.87	456.23
513+	Browning	454.15								
526				455.55		456.58			458.95	456.33
542				455.58		456.62			458.98	456.40
572				455.79		456.77			459.19	456.73
590	Bath	454.36		455.88		456.84			459.25	456.83
613				456.13		457.02			459.47	457.22
633	Havana	455.03	72,000	456.80	454.50	457.75	455.75	92,000	460.05	457.91
655			66,000	457.13		458.02		86,000	460.40	458.45
676	Liverpool	456.10		458.03	455.13	458.85	456.25		461.40	458.54
707				458.46		459.20			461.84	458.73
722	Copperas Creek	456.68		458.60	455.50	459.40	456.50		461.95	458.95
760				459.68		460.35			463.06	460.60
768+800	Kingston Mines	457.73								
781				460.20		460.83			463.63	461.40
790				460.47		461.07			463.90	461.73
807	Pekin	459.37	66,000	461.02	458.92	461.57	459.57	86,000	464.52	462.53
820			60,000	461.38		461.90		80,000	464.85	462.94
848			60,000	461.82		462.30		80,000	465.35	463.54

TABLE NO. 28—Concluded.

Stations.		A	1926 discharge.	B_1	B_2	C_1	C_2	1926 discharge +20,000 c.f.s.	D_1	D_2
855	Peoria	460.82	59,000	462.15	460.55	462.61	461.02	79,000	465.72	464.00
877				462.23	460.65	462.68	461.12		465.80	464.11
882				462.32	460.74	462.75	461.19		465.86	464.18
908				462.36	460.79	462.79	461.24		465.90	464.23
948			59,000	462.43	460.90	462.83	461.35	79,000	466.02	464.36
961	Chillicothe	461.32	58,000	462.58	461.12	462.98	461.55	78,000	466.18	464.58
998+	Lacon	461.49								
1005				462.87	461.47	463.27	461.90		466.35	464.92
1034+900	Henry	461.84								
		461.90	56,000	462.03	461.70	463.47	462.10	76,000	466.55	465.17
1069			55,000	463.18	461.90	463.61	462.28	75,000	466.30	465.37
1093				463.27	462.02	463.68	462.39		466.80	465.47
1096+100	Hennepin	462.15								
1130	DePue	462.55		463.54	462.36	463.93	462.70		467.08	465.81
1162				464.00	462.90	464.33	463.23		467.57	466.40
1174+300	Peru	463.10								
1185+400	LaSalle	464.13	55,000	464.55	463.52	464.85	463.82	75,000	468.11	467.05

LEVEE ENLARGEMENT AND LEVEE SET-BACKS.

The river levees should be at least three feet above high water with a standard cross-section top width eight feet and side slopes three horizontal to one vertical on each side. The quantities of material necessary to enlarge the levees, as shown in profiles on Figure No. 42, have been estimated for each levee district, as shown in Tables, Nos. 29 to 32 inclusive.

These estimates cover enlargement of levees and enlargement of levees with set backs for two conditions of discharge, viz.

1. With discharge for the October 1926 flood, with all levees holding and entering the Mississippi River at the high water stage of 1844.
2. A discharge from LaSalle to Grafton of 20,000 c. f. s. more than that of October 1926, with all levees holding, and entering the Mississippi River at the flood stage of 1844.

Computations for each condition of discharge have been made for levees enlarged on the present locations and for the levees enlarged with set backs, as shown on plan in Figure No. 40 and with the Chautauqua District left open.

TABLE NO. 29—LEVEE ENLARGEMENTS AND SET-BACKS, CUBIC YARDS OF FILL REQUIRED.

No.	Name.	Present levee.				Levee grade 3′ above computed profile for 1926 flood confined between levees and discharging at 1,844 H. W. at Grafton—present location.					
		Riverfront.		Returns.		Riverfront.			Returns.		
		Total in 1,000 cubic yards.	Length in 100 feet.	Total in 1,000 cubic yards.	Length in 100 feet.	Total in 1,000 cubic yards.	Average fill in feet.	Enlargement in 1,000 cubic yards.	Total in 1,000 cubic yards.	Average fill in feet.	Enlargement in 1,000 cubic yards.
1	Hennepin	----	----	----	----	----	----	----	----	----	----
2	East Peoria	173	64	23	20	265	18.0	92	33	11.0	10
3	Pekin and LaMarsh	494	165	128	80	1,070	17.3	576	250	14.3	122
4	Rocky Ford	444	135	312	135	584	18.4	140	455	16.1	143
5	Spring Lake	1,891	701	240	139	2,943	18.2	1,052	439	15.6	199
6	Banner Special	1,519	393	346	162	2,158	20.9	639	346	12.6	0
7	East Liverpool	585	172	73	193	952	21.0	367	573	15.1	500
8	Liverpool	129	37	620	338	211	21.4	82	1,301	17.3	681
9	Chautauqua	720	284	499	201	1,292	18.9	572	1,089	20.7	590
10	Thompson Lake	770	272	690	340	1,383	20.0	613	1,483	18.5	793
11	Crabtree	----	----	----	----	----	----	----	----	----	----
12	Spoon River	----	----	----	----	----	----	----	----	----	----
13	Lacey	163	63	167	167	214	16.2	51	519	15.4	352
14	Langellier	300	110	28	17	447	17.8	147	86	20.0	58
15	West Matanzas	636	220	308	218	960	18.5	324	602	14.4	294
16	Seahorn	----	----	----	----	----	----	----	----	----	----
17	Kerton Valley	----	----	----	----	----	----	----	----	----	----
18	Big Lake	749	278	72	134	1,339	19.5	590	261	11.9	189
19	Kelley Lake	245	118	95	109	544	19.1	299	373	16.2	278
20	Coal Creek	652	196	443	324	1,016	20.3	364	1,018	15.5	575
21	Lost Creek	114	67	25	111	263	17.5	149	112	18.3	87
22	Crane Creek	----	----	----	----	----	----	----	----	----	----
23	South Beardstown	1,444	440	242	186	2,164	19.7	720	722	17.4	480
24	Valley	----	----	----	----	----	----	----	----	----	----
25	Big Prairie	366	153	250	125	549	16.6	183	396	15.6	146
26	Meredosia Lake	212	270	100	157	765	14.7	553	350	12.9	250
27	Willow Creek	----	----	----	----	----	----	----	----	----	----
28	Little Creek, Kerr, Kerr-Crane	100	36	91	147	179	19.9	79	546	17.0	455
29	McGee Creek	877	407	391	386	2,127	20.4	1,250	792	12.3	401
30	Coon Run	----	----	----	----	----	----	----	----	----	----
31	Oaks	----	----	----	----	----	----	----	----	----	----
32	Mauvaisterre	----	----	----	----	----	----	----	----	----	----
33	Scott County	697	350	219	190	1,381	17.6	684	644	16.2	425

34	Valley City	500	248	274	202	1,143	19.1	643	644	15.7	370
35	Big Swan	865	361	231	274	1,501	18.2	636	944	16.3	713
36	Hillview	539	370	426	340	1,498	17.8	959	1,110	15.9	684
37	Hartwell	338	234	571	449	771	15.9	433	1,431	15.7	860
38	Fairbanks-Keach	705	287	870	693	1,150	17.7	445	1,942	14.6	1,072
39	Eldred	747	328	1,162	662	1,527	19.2	780	2,276	16.3	1,114
40	Spankey	----------	----------	125	195	----------	----------	----------	545	14.6	420
41	Nutwood	708	387	408	260	1,585	17.9	877	915	16.5	507
	Total	17,682	7,146	9,429	6,954	31,981	----------	14,299	22,197	----------	12,768

TABLE NO. 30—LEVEE ENLARGEMENTS AND SET-BACKS, CUBIC YARDS OF FILL REQUIRED.

No.	Name.	Levee grade 3′ above computed profile for 1926 flood confined between levees and discharging at 1844 H. W. at Grafton—with set-backs.					
		Riverfront.			Returns.		
		Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.	Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.
1	Hennepin	----	----	----	----	----	----
2	East Peoria	220	16.3	47	25	9.3	2
3	Pekin and LaMarsh	498	15.2	4	161	12.2	33
4	Rocky Ford	458	16.2	14	345	13.9	33
5	Spring Lake	2,273	15.8	382	323	13.2	83
6	Banner Special	1,658	18.2	139	224	9.9	----
7	East Liverpool	733	18.3	148	401	12.4	328
8	Liverpool	168	18.9	39	971	14.8	351
9	Chautauqua	----	----	----	----	----	----
10	Thompson Lake	1,089	17.7	319	1,155	16.2	465
11	Crab Tree	----	----	----	----	----	----
12	Spoon River	----	----	----	----	----	----
13	Lacey	168	14.2	5	399	13.4	232
14	Langellier	357	15.8	57	70	18.0	42
15	West Matanzas	773	16.5	137	453	12.4	145
16	Seahorn	----	----	----	----	----	----
17	Kerton Valley	----	----	----	----	----	----
18	Big Lake	1,090	17.5	341	185	9.9	113
19	Kelley Lake	443	17.1	198	290	14.2	195
20	Coal Creek	38	----	15	----	----	----
		*978	21.2	978	796	13.5	343
21	Lost Creek	210	15.5	96	381	16.3	356
22	Crane Creek	----	----	----	----	----	----
23	South Beardstown	1,251	----	236	----	----	----
		*628	20.6	628	603	15.8	361
24	Valley	----	----	----	----	----	----
25	Big Prairie	0	----	0	----	----	----
		*533	18.3	533	185	14.3	30
26	Meredosia Lake	664	13.6	452	298	11.8	198
27	Willow Creek	----	----	----	----	----	----
28	Little Creek (Kerr, Kerr Crane)	176	18.8	76	482	15.9	391
29	McGee Creek	1,899	19.2	1,022	553	10.1	162
30	Coon Run	----	----	----	----	----	----
31	Oaks	----	----	----	----	----	----
32	Mauvaisterre	----	----	----	----	----	----
33	Scott County	460	----	226	----	----	----
		*792	18.4	792	580	15.3	361
34	Valley City	167	18.1	70	----	----	----
		*883	19.0	883	573	14.7	299
35	Big Swan	751	----	266	----	----	----
		*910	20.1	910	888	15.8	657
36	Hillview	1,466	17.6	927	1,089	15.7	663
37	Hartwell	771	15.9	433	1,431	15.7	860
38	Fairbanks-Keach	1,150	17.7	445	1,942	14.6	1,072
39	Eldred	1,527	19.2	780	2,276	16.3	1,114
40	Spankey	----	----	----	545	14.6	420
41	Nutwood	1,585	17.9	877	915	16.5	507
	Total	26,767	----	12,475	18,529	----	9,816

* Set-back levees.

TABLE NO. 31—LEVEE ENLARGEMENTS AND SET-BACKS, CUBIC YARDS OF FILL REQUIRED.

No	Name.	Levee grade 3′ above computed profile for 1926 flood+20,000 c.f.s. confined between levees and discharging at 1844 H. W. at Grafton—present location.					
		Riverfront.			Returns.		
		Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.	Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.
1	Hennepin						
2	East Peoria	353	21.0	180	52	14.0	29
3	Pekin and LaMarsh	847	20.2	353	338	18.2	210
4	Rocky Ford	766	21.3	322	617	19.0	305
5	Spring Lake	3,837	20.9	1,946	593	18.3	353
6	Banner Special	2,707	23.6	1,188	495	15.3	149
7	East Liverpool	1,175	23.5	590	765	17.6	692
8	Liverpool	259	23.8	130	1,655	19.7	1,035
9	Chautauqua	1,611	21.3	891	1,329	23.1	830
10	Thompson Lake	1,697	22.4	927	1,778	20.4	1,088
11	Crab Tree						
12	Spoon River						
13	Lacey	277	18.6	114	676	17.8	509
14	Langellier	565	20.2	265	106	22.4	78
15	West Matanzas	1,215	21.0	579	801	16.9	493
16	Seahorn						
17	Kerton Valley						
18	Big Lake	1,662	21.9	913	361	14.3	289
19	Kelley Lake	681	21.5	436	479	18.6	384
20	Coal Creek	1,244	22.6	592	1,312	17.8	869
21	Lost Creek	381	19.8	267	591	20.6	566
22	Crane Creek						
23	South Beardstown	2,653	22.0	1,209	911	19.7	669
24	Valley						
25	Big Prairie	686	18.8	320	506	17.8	256
26	Meredosia Lake	1,003	17.0	791	474	15.2	374
27	Willow Creek						
28	Little Creek (Kerr, Kerr Crane)	219	22.1	119	686	19.2	595
29	McGee Creek	2,561	22.5	1,684	1,054	14.4	663
30	Coon Run						
31	Oaks						
32	Mauvaisterre						
33	Scott County	1,681	19.5	984	793	18.1	574
34	Valley City	1,382	21.1	882	809	17.7	535
35	Big Swan	1,767	19.7	902	1,109	17.8	878
36	Hillview	1,726	19.2	1,187	1,305	17.3	879
37	Hartwell	888	17.2	550	1,668	17.0	1,097
38	Fairbanks-Keach	1,287	18.8	582	2,220	15.7	1,350
39	Eldred	1,668	20.1	921	2,514	17.2	1,352
40	Spankey				603	15.4	478
41	Nutwood	1,667	18.4	959	966	17.0	558
	Total	38,465		20,783	27,566		18,137

TABLE NO. 32—LEVEE ENLARGEMENTS AND SET-BACKS, CUBIC YARDS OF FILL REQUIRED.

No.	Name.	Levee grade 3′ above computed profile for 1926 flood+20,000 c.f.s. confined between levees and discharging at 1844 H. W. at Grafton—with set-backs.					
		Riverfront.			Returns.		
		Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.	Total in 1,000 cu. yds.	Average fill in ft.	Enlargement in 1,000 cu. yds.
1	Hennepin	--------	--------	--------	--------	--------	--------
2	East Peoria	302	19.3	129	41	12.3	18
3	Pekin and LaMarsh	689	18.1	195	238	15.1	110
4	Rocky Ford	624	19.1	180	491	16.8	179
5	Spring Lake	2,958	18.2	1,067	440	15.6	200
6	Banner Special	2,151	20.9	632	346	12.6	0
7	East Liverpool	924	20.7	339	554	14.8	481
8	Liverpool	210	21.3	81	1,283	17.2	663
9	Chautauqua	--------	--------	--------	--------	--------	--------
10	Thompson Lake	1,422	20.4	652	1,540	18.9	850
11	Crab Tree	--------	--------	--------	--------	--------	--------
12	Spoon River	--------	--------	--------	--------	--------	--------
13	Lacey	219	16.4	56	529	15.6	362
14	Langellier	455	18.0	155	87	20.2	59
15	West Matanzas	977	18.7	341	611	14.6	303
16	Seahorn	--------	--------	--------	--------	--------	--------
17	Kerton Valley	--------	--------	--------	--------	--------	--------
18	Big Lake	1,267	19.4	518	254	11.8	182
19	Kelley Lake	534	18.9	289	362	16.0	267
20	Coal Creek	53	--------	30	--------	--------	--------
		*1,123	22.8	1,123	978	15.2	535
21	Lost Creek	254	17.2	140	459	18.0	434
22	Crane Creek	--------	--------	--------	--------	--------	--------
23	South Beardstown	1,491	--------	476	--------	--------	--------
		*724	22.2	724	729	17.5	487
24	Valley	--------	--------	--------	--------	--------	--------
25	Big Prairie	0	--------	0	104	--------	73
		*577	19.1	577	--------	--------	--------
26	Meredosia Lake	815	15.2	603	376	13.4	276
27	Willow Creek	--------	--------	--------	--------	--------	--------
28	Little Creek (Kerr, Kerr Crane)	186	20.3	86	570	17.4	479
29	McGee Creek	2,168	20.6	1,291	813	12.5	422
30	Coon Run	--------	--------	--------	--------	--------	--------
31	Oaks	--------	--------	--------	--------	--------	--------
32	Mauvaisterre	--------	--------	--------	--------	--------	--------
33	Scott County	535	--------	301	--------	--------	--------
		*927	20.0	927	690	16.8	471
34	Valley City	159	--------	62	--------	--------	--------
		*990	20.0	990	663	15.9	389
35	Big Swan	878	--------	393	--------	--------	--------
		*1,070	21.9	1,070	1,074	17.5	843
36	Hillview	1,726	19.2	1,187	1,305	17.3	879
37	Hartwell	888	17.2	550	1,668	17.0	1,097
38	Fairbanks-Keach	1,287	18.8	582	2,220	15.7	1,350
39	Eldred	1,668	20.1	921	2,514	17.2	1,352
40	Spankey	--------	--------	--------	603	15.4	478
41	Nutwood	1,667	18.4	959	966	17.0	558
	Total	31,918	--------	17,626	22,508	--------	13,797

* Set-back levees.

Details of the levee heights were not available for a number of the districts listed in the foregoing tables where the quantities are omitted. The approximate amount of enlargement for the levees in these districts was estimated at the average height of all levees scheduled in the Tables 29 to 32. The following Table No. 33 is a resumé of the dimensions and volumes of levees and Table No. 34 contains estimates of cost of enlargement and set-backs as shown.

TABLE NO. 33—RESUME OF LEVEE ENLARGEMENT AND LEVEE SET-BACKS FROM GRAFTON TO PEORIA.

	River-front.	Returns.	Total.
1. Present levees—			
.1 Length of levees in feet	714,600	695,400	1,410,000
Length of levees in miles	135.5	131.8	267.3
.2 Fill in cubic yards	17,682,000	9,429,000	27,111,000
.3 Average height of levees, feet	15.8	11.5	13.8
2. Levees 3 feet above high water profile for 1926 flood discharge all levees holding and entering Mississippi River at 1844 flood stage—			
.1 Total enlarged levees, cubic yards	31,981,000	22,197,000	54,178,000
.2 Average height of levees, feet	18.8	15.7	17.3
.3 Enlargement, cubic yards	14,299,000	12,768,000	27,067,000
3. Levees 3 feet above high water profile for 1926 flood discharge all levees holding and entering Mississippi River at 1844 flood stage and with levee setbacks as shown in Figure No. 40.			
.1 Length of set-back in feet	108,800	----------	----------
Length of set-back in miles	20.6	----------	----------
.2 Length of levees used and set-backs in feet	686,200	675,300	136,500
Length of levees used and set-backs in miles	130	128	258
.3 Enlarged levees used, cubic yards	22,043,000	----------	----------
.4 Set-back levees, cubic yards	4,724,000	----------	----------
.5 Total enlarged set-back levees	26,767,000	18,529,000	45,296,000
.6 Average height of levees, feet	17.4	14.5	16.0
.7 Enlargement and set-backs, cubic yards	12,475,000	9,816,000	22,291,000
4. Levees 3 feet above high water profile for discharge 20,000 c.f.s. greater than 1926 flood discharge from Grafton to LaSalle, all levees holding and entering Mississippi River at 1844 flood stage—			
.1 Length of levees in feet	714,600	695,400	1,410,000
Length of levees in miles	135.5	131.8	267.3
.2 Total enlarged levees, cubic yards	38,465,000	27,566,000	66,031,000
.3 Average height of levees, feet	20.7	17.6	19.2
.4 Enlargement, cubic yards	20,783,000	18,137,000	38,920,000
5. Levees 3 feet above high water profile for discharge 20,000 c.f.s. greater than 1926 flood discharge from Grafton to LaSalle, all levees holding and entering Mississippi River at 1844 flood stage and with levees set-backs as shown in Figure No. 40.			
.1 Length of set-back in feet	108,800	----------	----------
Length of set-back in miles	20.6	----------	----------
.2 Length of levees used and set-backs in feet	686,200	675,300	1,361,500
Length of levees used and set-backs in miles	130	128	258
.3 Enlarged levees used, cubic yards	26,507,000	----------	----------
.4 Set-back levees, cubic yards	5,411,000	----------	----------
.5 Total enlarged and set-back levees, feet	31,918,000	22,508,000	54,426,000
.6 Average height of levees	19.2	16.1	17.7
.7 Enlargement and set-backs, cubic yards	17,626,000	13,797,000	31,423,000

For construction estimates, surveys and detail studies of location for set-back levees will be necessary, but the estimates herein are relatively correct.

TABLE NO. 34—ESTIMATED COST FOR THE ENLARGEMENT OF LEVEES ON THE PRESENT LOCATIONS AND FOR THE ENLARGEMENT OF LEVEES USED WITH SET-BACK LEVEES.

1. Levees 3 feet above high water profile for 1926 flood discharge all levees holding and entering Mississippi River at 1844 flood stage—			
Levee enlargement as per table	27,667,000	cubic yards	
Levee enlargement districts not detailed	3,225,000		
	30,892,000	cubic yards at $0.25	$7,723,000
Right-of-way 267.0 miles at $2,500			667,000
Estimated cost			$8,390,000
2. Levees 3 feet above high water profile for 1926 flood discharge all levees holding and entering Mississippi River at 1844 flood stage and with levee set-backs as shown in Figure No. 40-			
Levee enlargement and set-backs as per table	22,291,000	cubic yards	
Levee enlargement districts not detailed	2,404,000		
	24,695,000	cubic yards at $0.25	$6,174,000
Right-of-way 258 miles at $2,500	$ 640,000		
7,600 acres set-back area at $200	1,520,000		
			2,160,000
Moving pump stations and changing ditches			150,000
Estimated cost			$8,484,000
3. Levees 3 feet above high water profile for discharge 20,000 c.f.s. greater than 1926 flood discharge from Grafton to LaSalle all levees holding and entering Mississippi River at 1844 flood stage—			
Levee enlargement as per table	38,920,000	cubic yards	
Levee enlargement districts not detailed	4,579,000		
	43,499,000	cubic yards at $0.25	$10,875,000
Right-of-way 267 miles at $2,500			667,000
Estimated cost			$11,542,000
4. Levees 3 feet above high water profile for discharge 20,000 c.f.s. greater than 1926 flood discharge from Grafton to LaSalle all levees holding and entering Mississippi River at 1844 flood stage and with levee set-backs as shown in Figure No. 40.			
Levee enlargement and set-backs as per table	31,423,000	cubic yards	
Levee enlargement districts not detailed	3,499,000		
	34,922,000	cubic yards at $0.25	$8,730,000
Right-of-way 258 miles at $2,500	$ 640,000		
7,600 acres set-back area at $200	1,520,000		
			$2,160,000
Moving pump stations and changing ditches			150,000
Estimated cost			$11,040,000

LEVEE ENLARGEMENT SPECIFICATIONS.

The plans and specifications for the strengthening and enlargement of the levees should provide a greater factor of safety in cross-section as well as greater height. Most of the levees along the Illinois River have what may be regarded as a minimum workable cross-section with top widths of from two feet to six feet and combined side slopes ranging from four to five horizontal to one vertical. One or more levees have been constructed with combined side slopes of six horizontal to one vertical. Besides greater volume for resistance to pressure and seepage, it is important that the levees should be constructed with slopes flat enough so that team work may be done in cutting the vegetation to keep the levees properly surfaced and sodded. This has not been practicable with most of the levees left in the rough as constructed by dredges. Experience in levee maintenance shows that a side slope of three horizontal to one vertical is practically the steepest that can be traveled with teams or with tractors suitable for keeping the levee in condition. The type of soil usually found along the banks of the Illinois River is very

effective in resisting seepage, otherwise there would have been many more failures of the Illinois River levees. For estimating purposes and as a recommendation, we have used minimum dimensions for the cross-sections of levees, as follows: Top width eight feet, side slopes on both sides of three horizontal to one vertical,* with banquettes at all sloughs and low places where levees are more than 18 feet high. The levees should be surfaced and seeded to grass and either grazed with cattle, horses or sheep so as to keep the vegetation down, or clipped once or twice a year with a mowing machine.

For protection of levees on the water side from erosion by wave action it will be necessary to maintain a growth of willows or other trees in front of the levee. Where the river bank is not high enough to sustain a natural growth of timber sufficient to protect the levee, a special berm should be constructed on the river side of the levee and planted with willows, which could be cut back from time to time so as to keep the growth of willows a few feet higher than the top of the levee and thick enough on a narrow strip or berm to protect the levee from erosion by wave action.

CHAUTAUQUA DRAINAGE DISTRICT LEFT OPEN.

The computations for high water profiles with levee set-backs contemplate leaving the Chautauqua Drainage District open for flow and storage. If the Chautauqua District levee should be reconstructed high enough and strong enough to hold, the flood stages would be one and one-half feet higher at the head of the district just above Liverpool, one foot higher at Kingston and 0.75 of a foot higher at Peoria with a corresponding increase in height, Peoria to LaSalle. With this showing the lowering of water stage by leaving the Chautauqua District open, no separate estimate has been made of comparison of cost of the land in the Chautauqua District, as compared with the cost of raising levees an amount corresponding to the increased river stages which would be produced by rebuilding these levees.

CITIES ALONG THE ILLINOIS RIVER.

The City of Beardstown was invaded by floods in 1922, 1926 and 1927. After the flood of 1922 the Illinois Legislature made an appropriation for the construction of flood protection works, but the State and City authorities were unable to agree as to the plan until after the flood of 1926. The flood control works consist of a concrete "seawall" along the river front in the business portion of the city, and an earth levee from the ends of the "seawall," around both sides of the city back to the high land above overflow. The top of the "seawall" is at elevation 455 Memphis Datum, which is 27.75 feet on the Illinois River gage at Beardstown. Provision has also been made for flash boards two feet high on the top of the wall. The earth levee is constructed to a grade four feet above the top of the wall, or two feet above the flash boards.

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* NOTE: By Division of Waterways—
It is believed that no one standard levee section can be selected as suitable for all locations along the Illinois River. The section used for construction in any location should be based on height of levee, kind of soil and exposure to wave action.

The high water of 1926 was 26.36 feet on the river gage at Beardstown, which is about 1.4 feet below the top of the "seawall." The flood height for 1926, with all levees holding, would have been elevation 455.4 Memphis Datum, or .4 of a foot above the concrete wall, and 1.6 feet below the top of the flash boards on the "seawalls."

With all levees holding and with a flood 20,000 c. f. s. greater than that of 1926 entering the Mississippi River at the 1844 flood stage, the river would be 5.2 feet higher than in 1926, which is elevation 458.8 Memphis Datum, or .2 of a foot below the top of the Beardstown earth levee and 1.8 feet above the top of the flash boards for the "seawall." With levees set back as proposed, the river stage for the same maximum flood would be at elevation 456.13 Memphis Datum, which is .87 of a foot below the top of the flash boards.

At Peoria, Water street and the railroad tracks in the vicinity of the Rock Island depot were flooded in 1926. The estimated maximum flood height at Peoria, with all levees holding, would be 4.90 feet higher than the observed stage of 1926, or, with the levees set back as proposed, 3.18 feet higher than the stage of 1926.

Smaller towns along the Illinois River, Browning, Frederick, Meredosia, Valley City and Naples were all flooded in 1922, 1926 and 1927. Meredosia and Naples have increased their levee protection, but with increased flood stages these smaller towns will be flooded to greater depth and will require enlargement and raising of their levees.

In the reach of the river between Peoria and Pekin, there is a considerable amount of overflowed land which has not been reclaimed. The industrial development in this locality points to the early demand for reclaiming of a considerable portion of this area for manufacturing sites. Computations have been made of the effect of leveeing the Illinois River on both sides, from Peoria to Pekin, with an allowance of 1,500 feet between levees, in accordance with the present rule of the U. S. Army Engineers for harbor lines, which shows that if these levees be constructed the flood stage at Peoria would be increased by reason thereof 1.30 feet, which is in excess of the estimated flood stages as shown in the tables and profiles in this report.

THE VALLEY DISTRICTS NEAR BEARDSTOWN.

East of Beardstown is an area of about 10,000 acres of second bottom land lying at an elevation between the 20-foot and 25-foot marks on the river gauge at Beardstown. This land has been for many years in a high state of cultivation and was not overflowed prior to construction of the levees, but subjected to frequent and disastrous flooding since. Levees of moderate height would protect these lands from overflow, but would also reduce the available storage between Havana and Beardstown about 25 per cent. equal to an increase discharge of 2,500 c. f. s. at Beardstown when the river is rising at the rate of 0.5 foot per day.

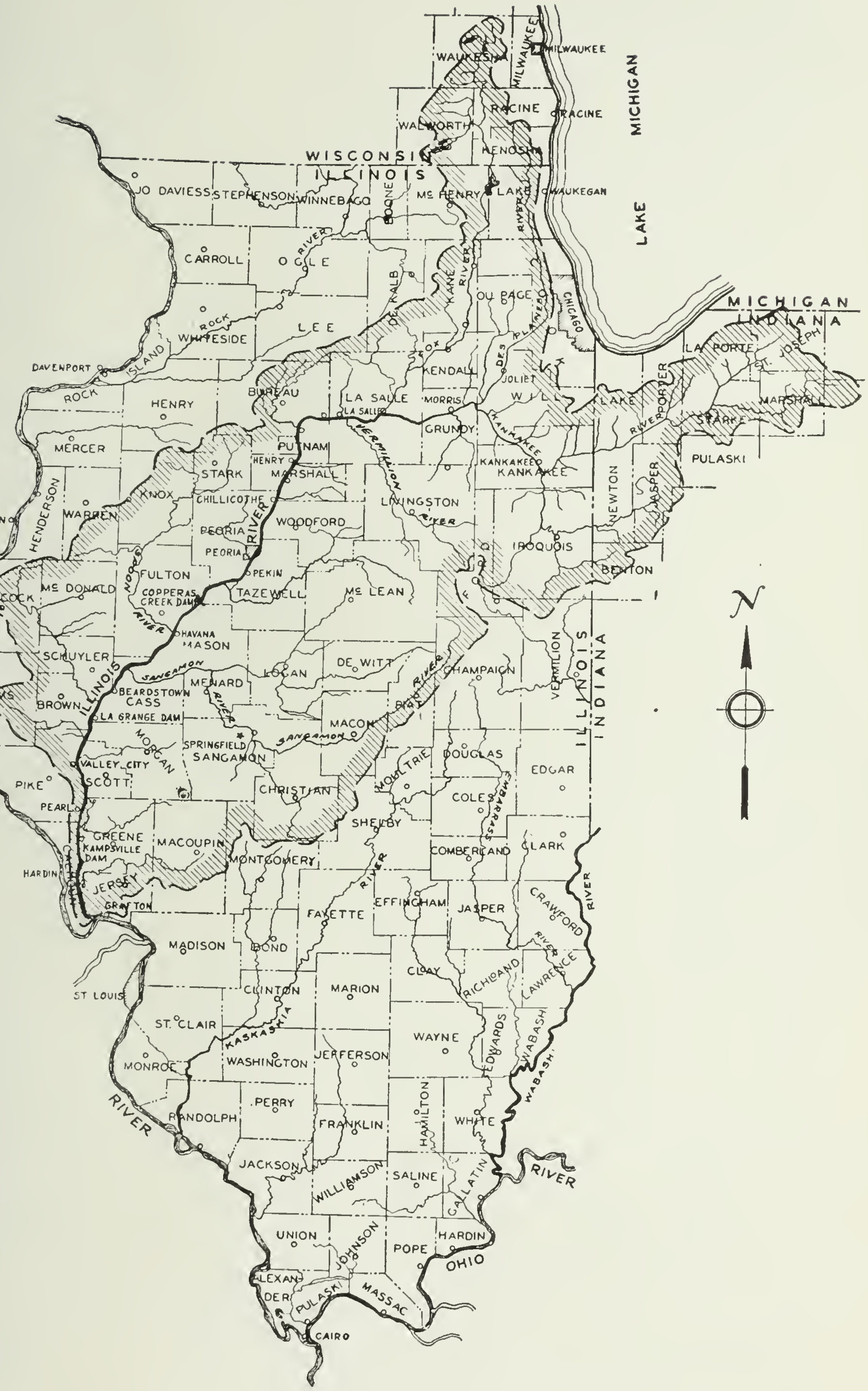


FIGURE NO. 1
REPORT OF 1928

MAP OF ILLINOIS
SHOWING
THE WATERSHED OF THE ILLINOIS RIVER
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY
JACOB A. HARMAN, CONSULTING ENGINEER
1928

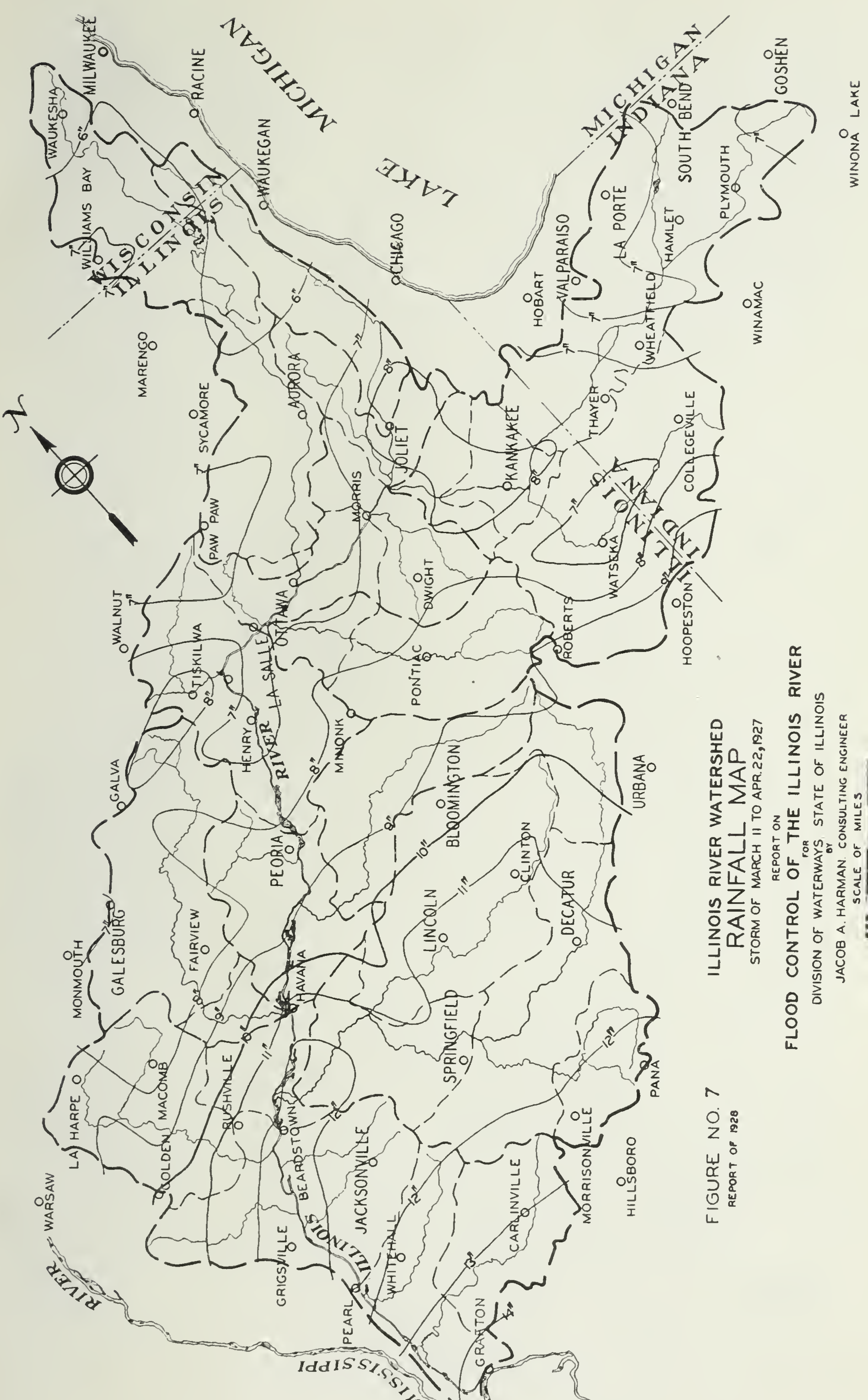


FIGURE NO. 7
REPORT OF 1928

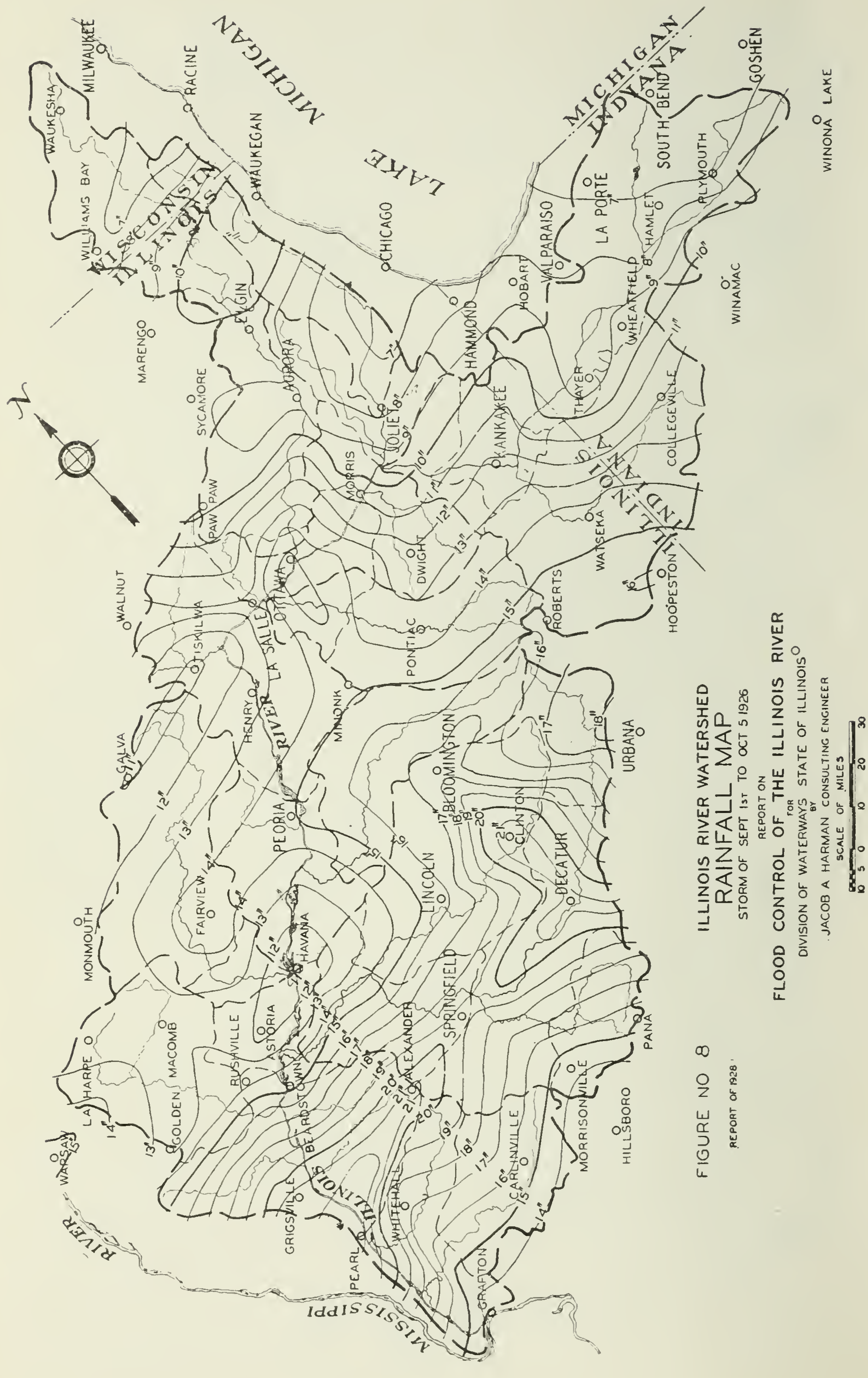


FIGURE NO 8

REPORT OF 1928

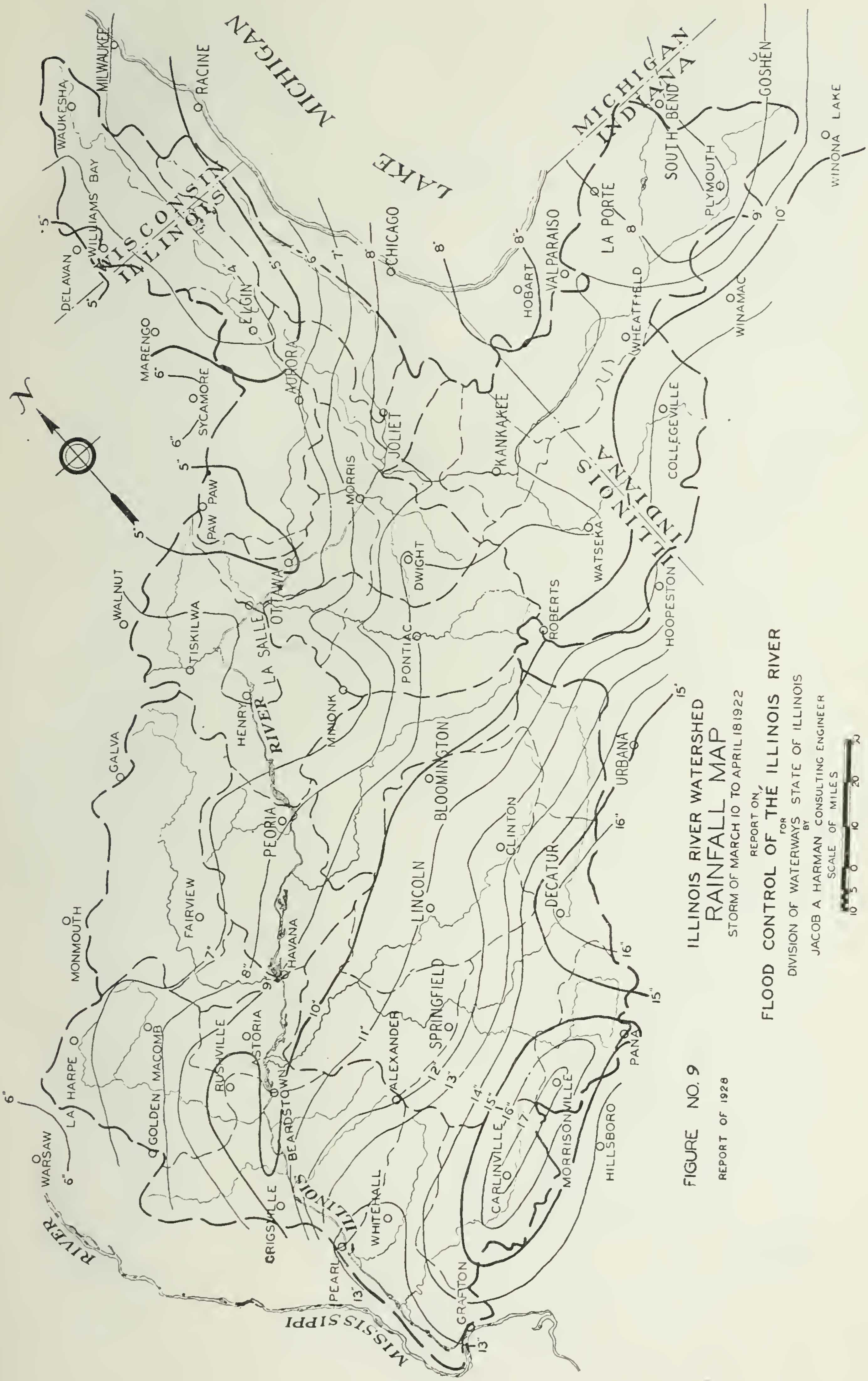


FIGURE NO. 9
REPORT OF 1928

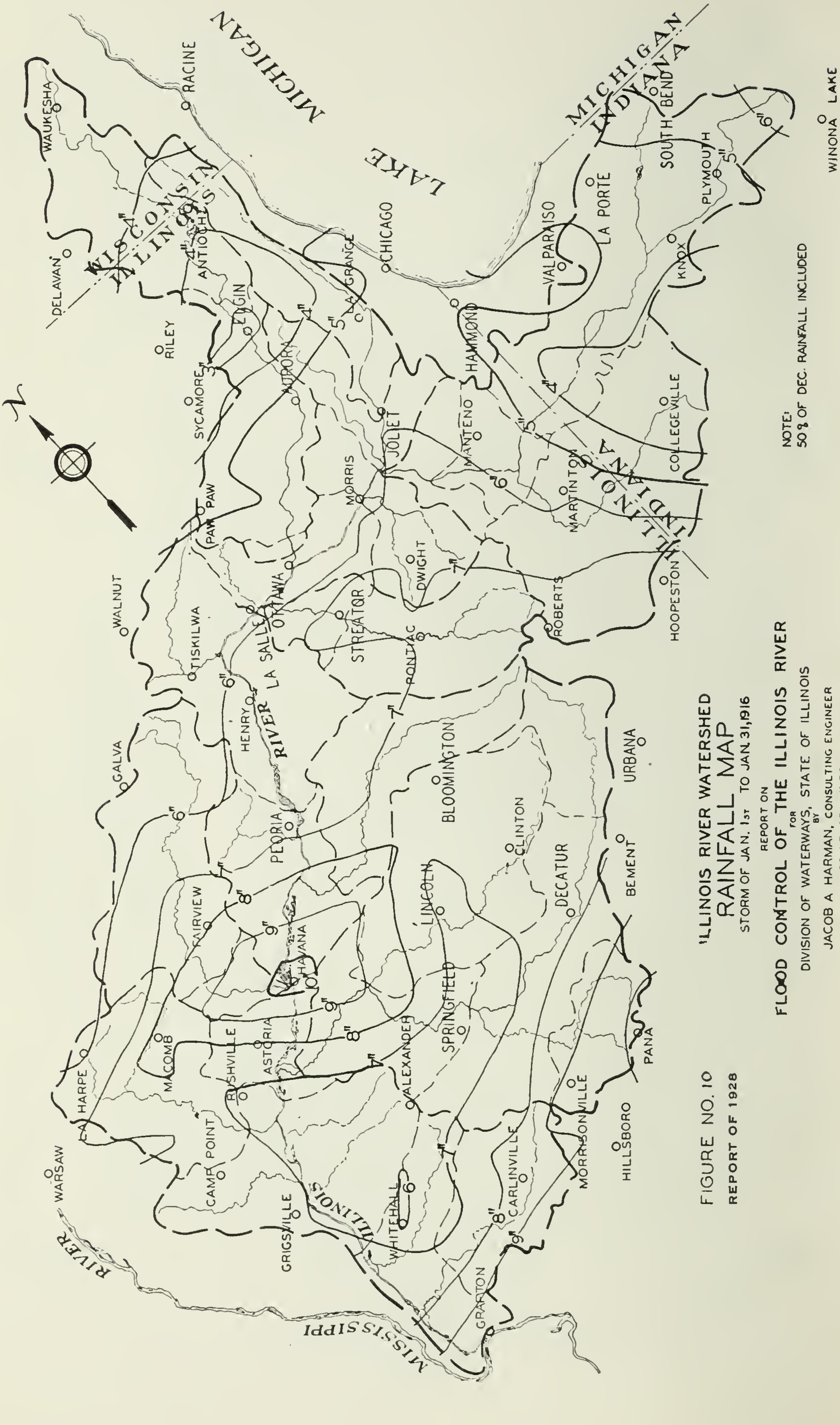


FIGURE NO. 10
REPORT OF 1928

ILLINOIS RIVER WATERSHED
RAINFALL MAP
STORM OF JAN. 1ST TO JAN. 31, 1916
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
FOR
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY
JACOB A. HARMAN, CONSULTING ENGINEER

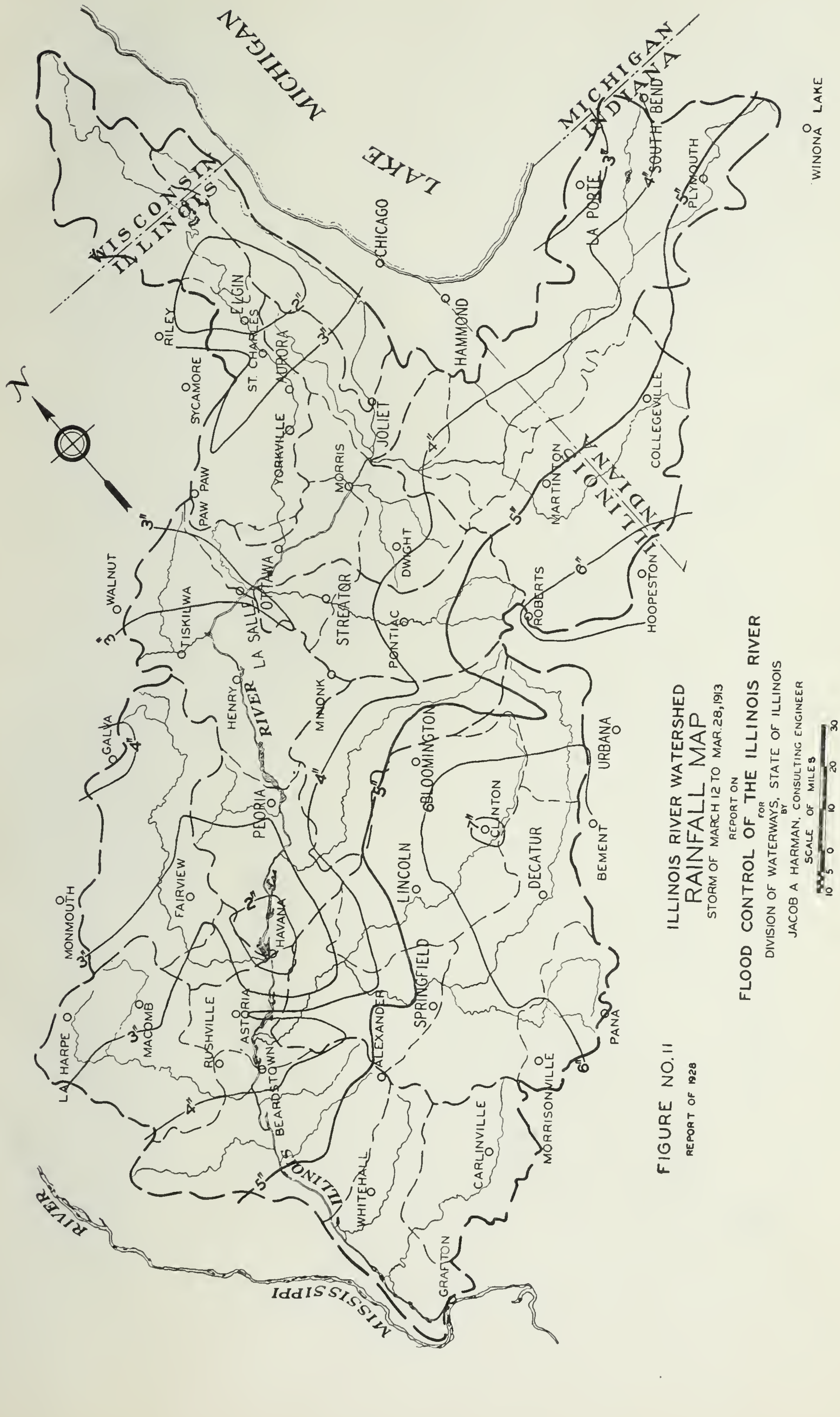


FIGURE NO. 11
REPORT OF 1928

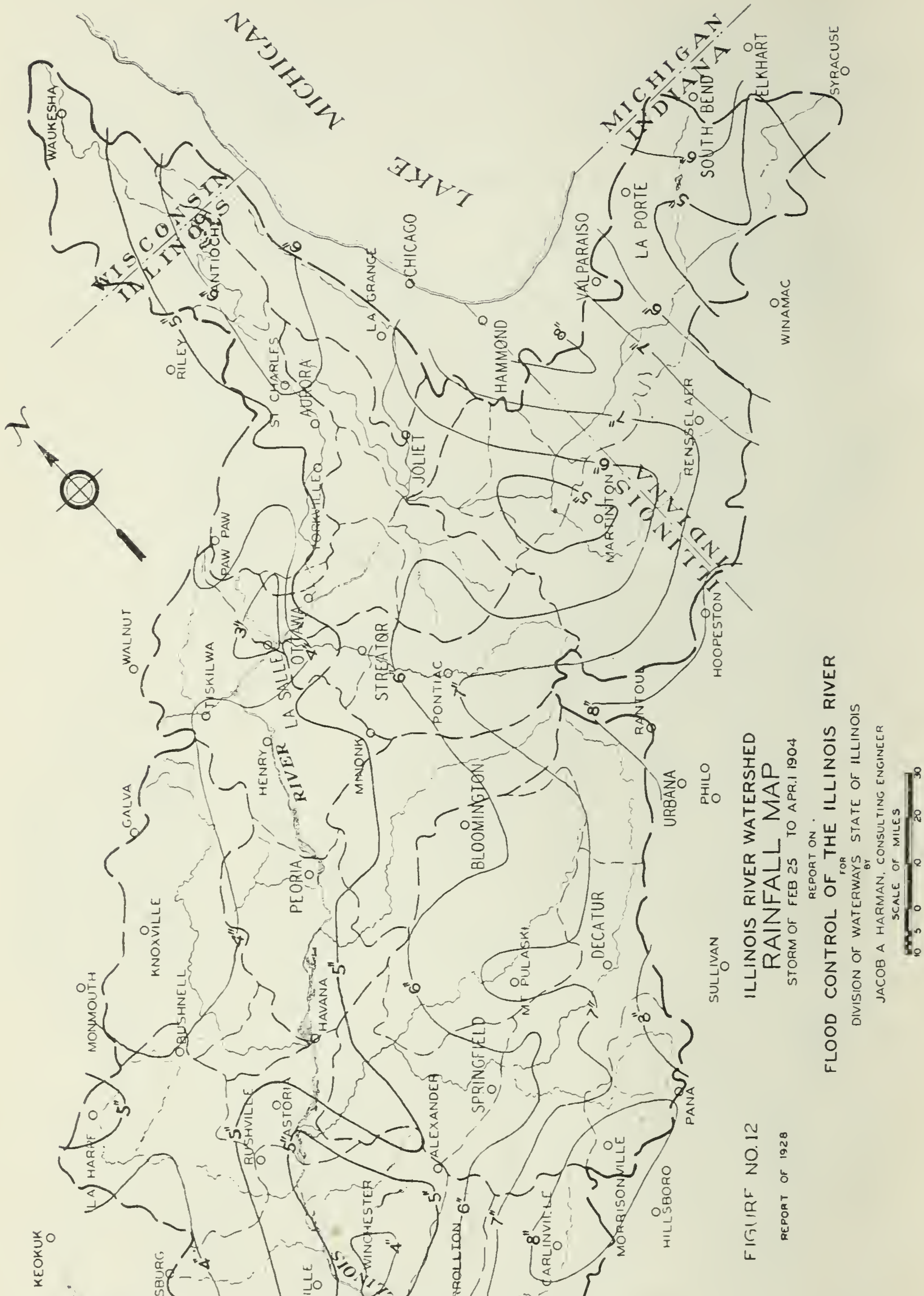


FIGURE NO. 12

REPORT OF 1928

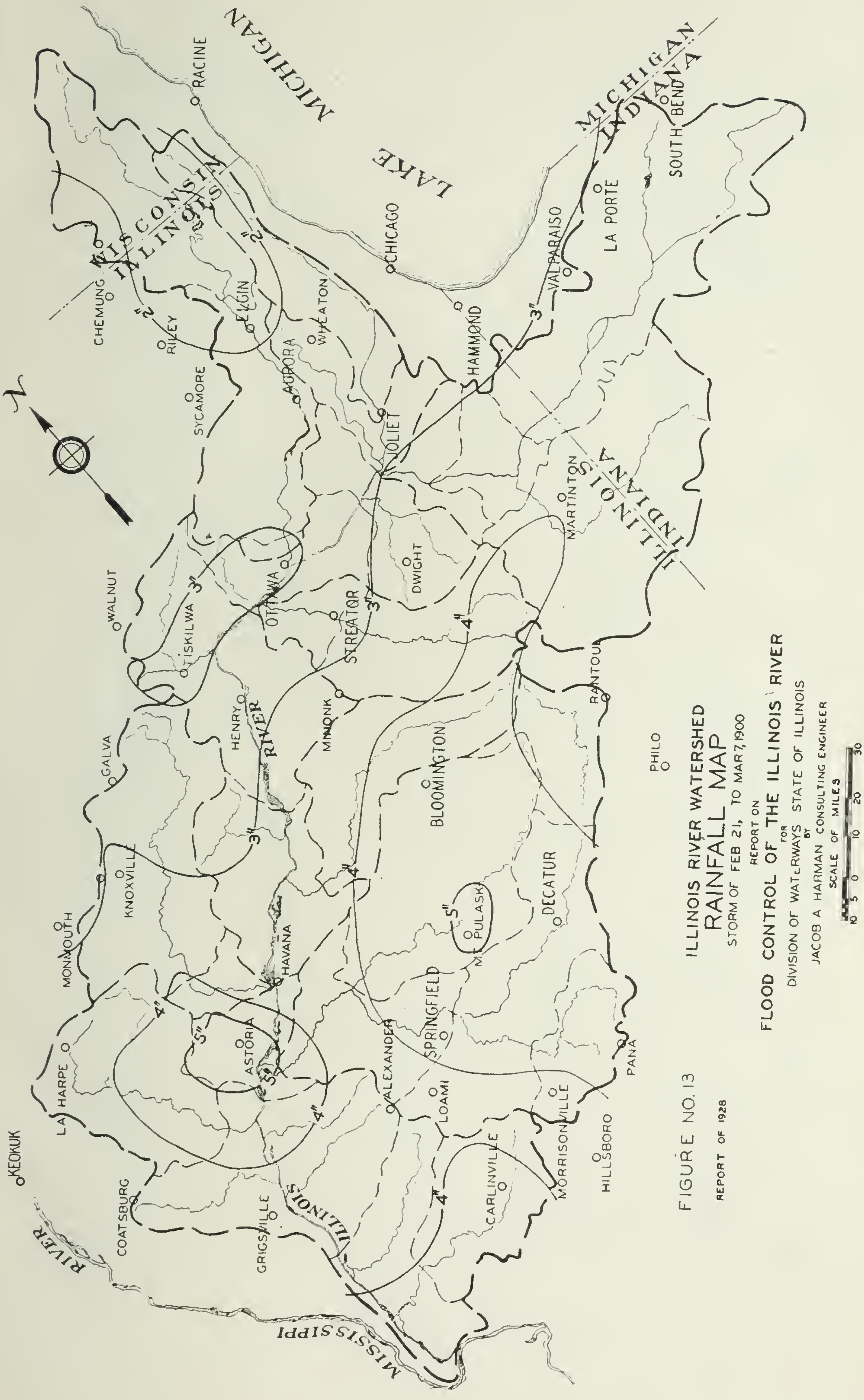


FIGURE NO. 13

REPORT OF 1928

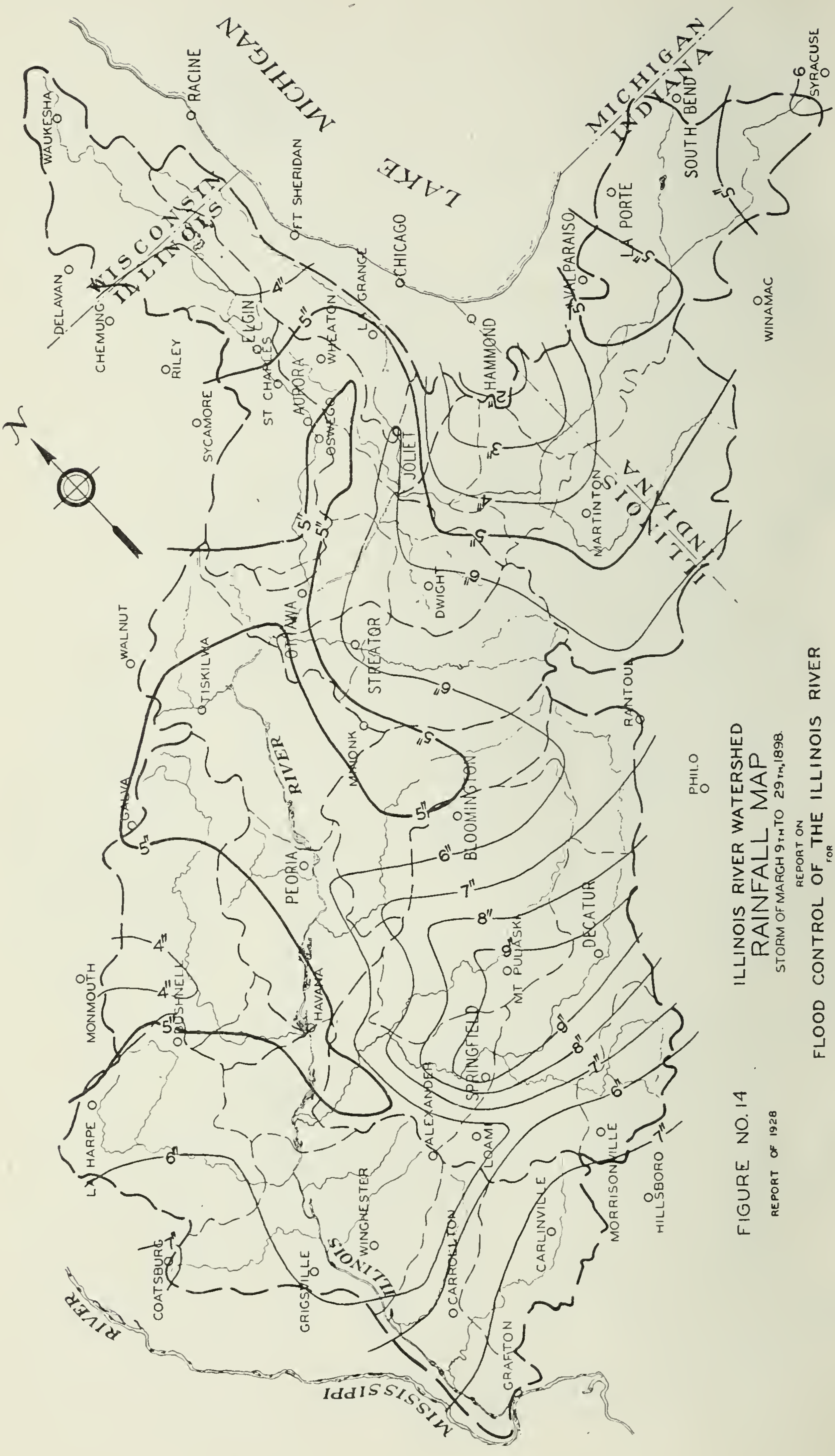
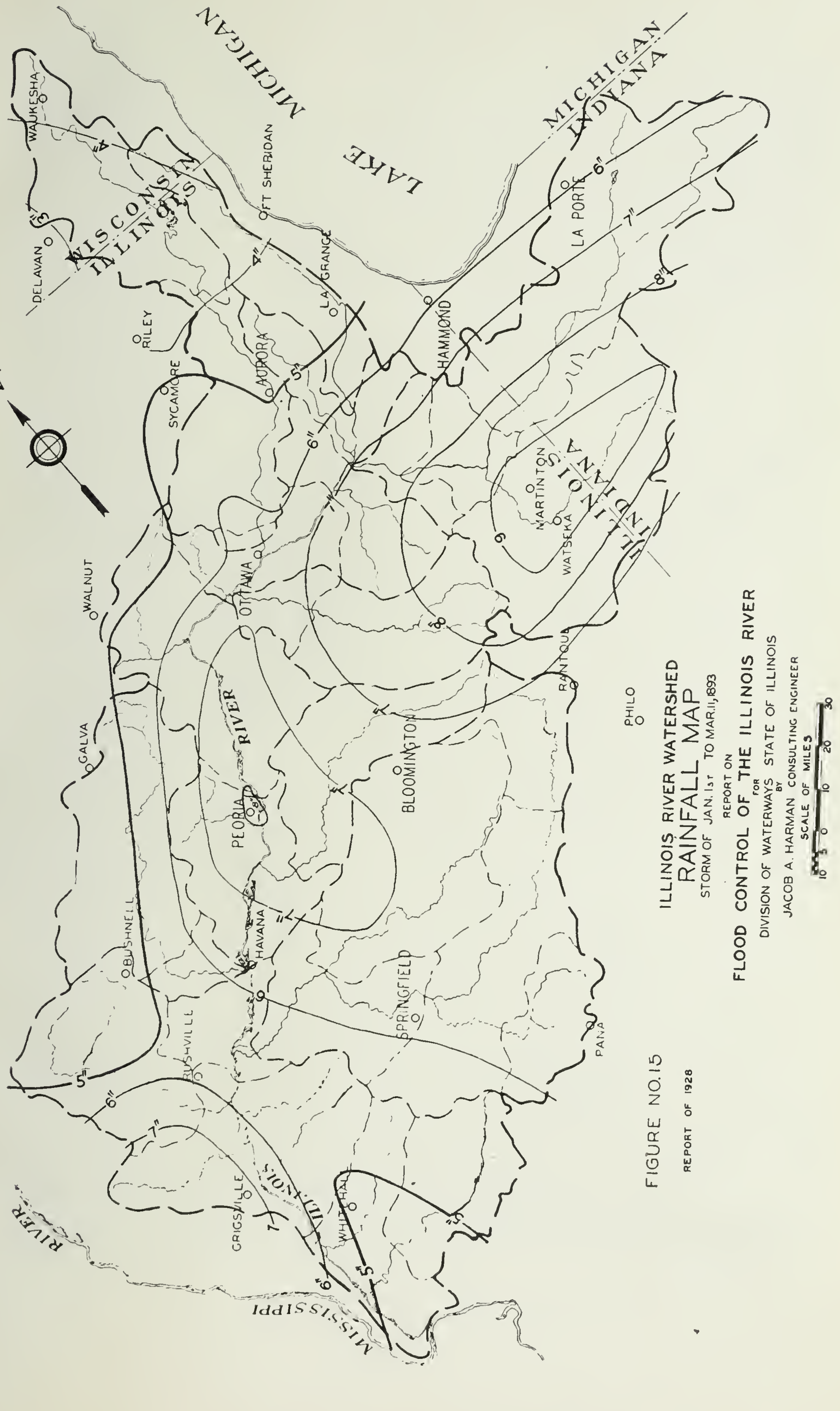


FIGURE NO. 14
REPORT OF 1928

ILLINOIS RIVER WATERSHED
RAINFALL MAP
STORM OF MARCH 9TH TO 29TH, 1898.
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
FOR
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A HARMAN CONSULTING ENGINEER
SCALE OF MILES
10 5 0 10 20 30


LAKE MICHIGAN
MICHIGAN
INDIANA
WISCONSIN
ILLINOIS
INDIANA
ILLINOIS
ILLINOIS RIVER
MISSISSIPPI RIVER
WAUKESHA
DELAVAN
FT SHERIDAN
LA GRANGE
RILEY
SYCAMORE
AURORA
HAMMOND
LA PORTE
MARTINTON
WATSEKA
WALNUT
OTTAWA
RANTOUL
PHILO
GALVA
PEORIA
BLOOMINGTON
BUSHNELL
HAVANA
SPRINGFIELD
PANA
RUSHVILLE
GRIGSVILLE
WHITEHALL
ILLINOIS RIVER WATERSHED
RAINFALL MAP
STORM OF JAN. 1st TO MAR. 11, 1893
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
FOR
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
SCALE OF MILES
10 5 0 10 20 30
FIGURE NO. 15
REPORT OF 1928

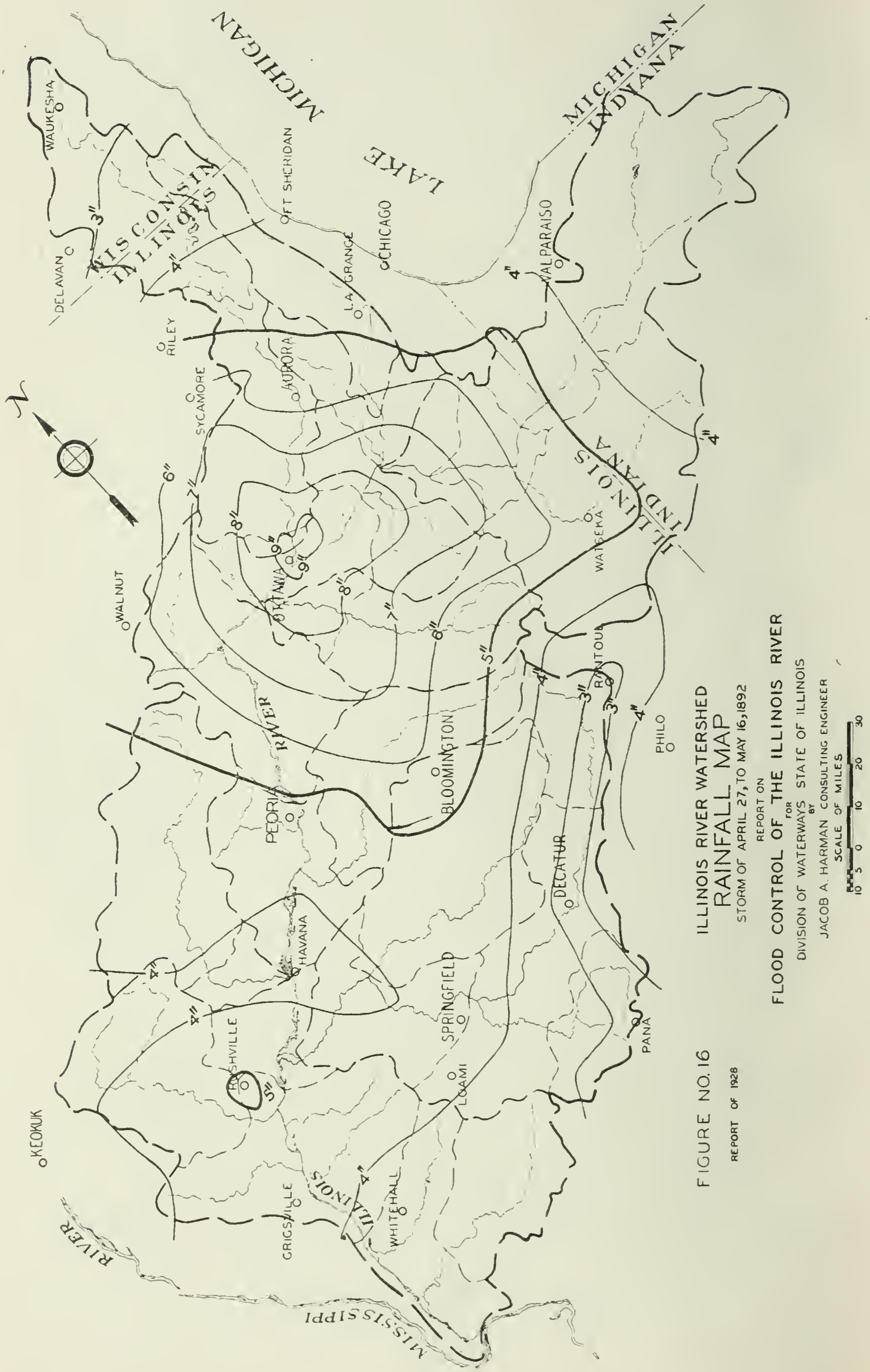


FIGURE NO. 16
REPORT OF 1928

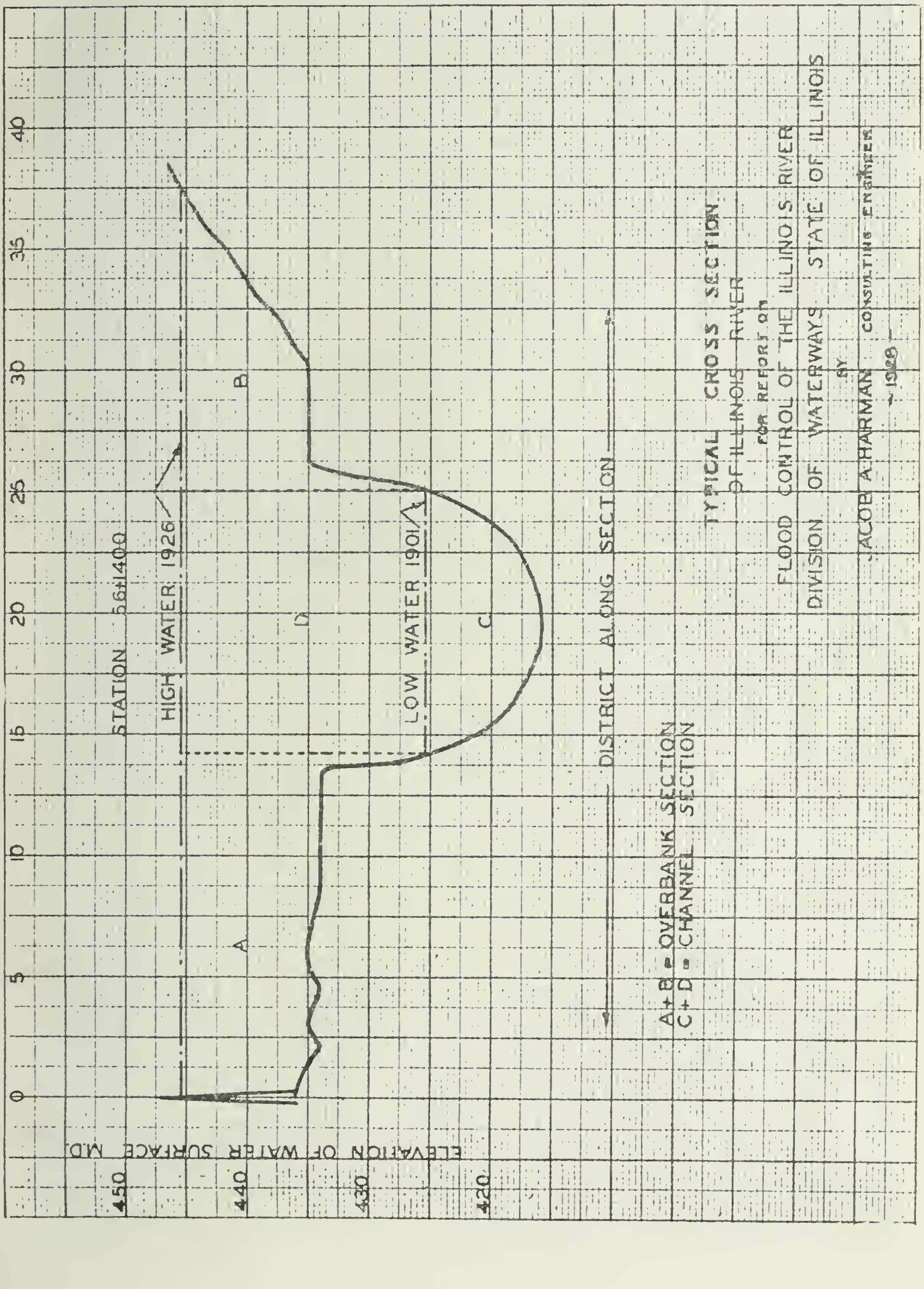

STATION 56+400
HIGH WATER 1926
LOW WATER 1901
DISTRICT ALONG SECTION
A+B = OVERBANK SECTION
C+D = CHANNEL SECTION
TYPICAL CROSS SECTION
OF ILLINOIS RIVER
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
1928
ELEVATION OF WATER SURFACE M.D.
A
B
C
D
0
5
10
15
20
25
30
35
40
450
440
430
420

FIG. NO. 17.

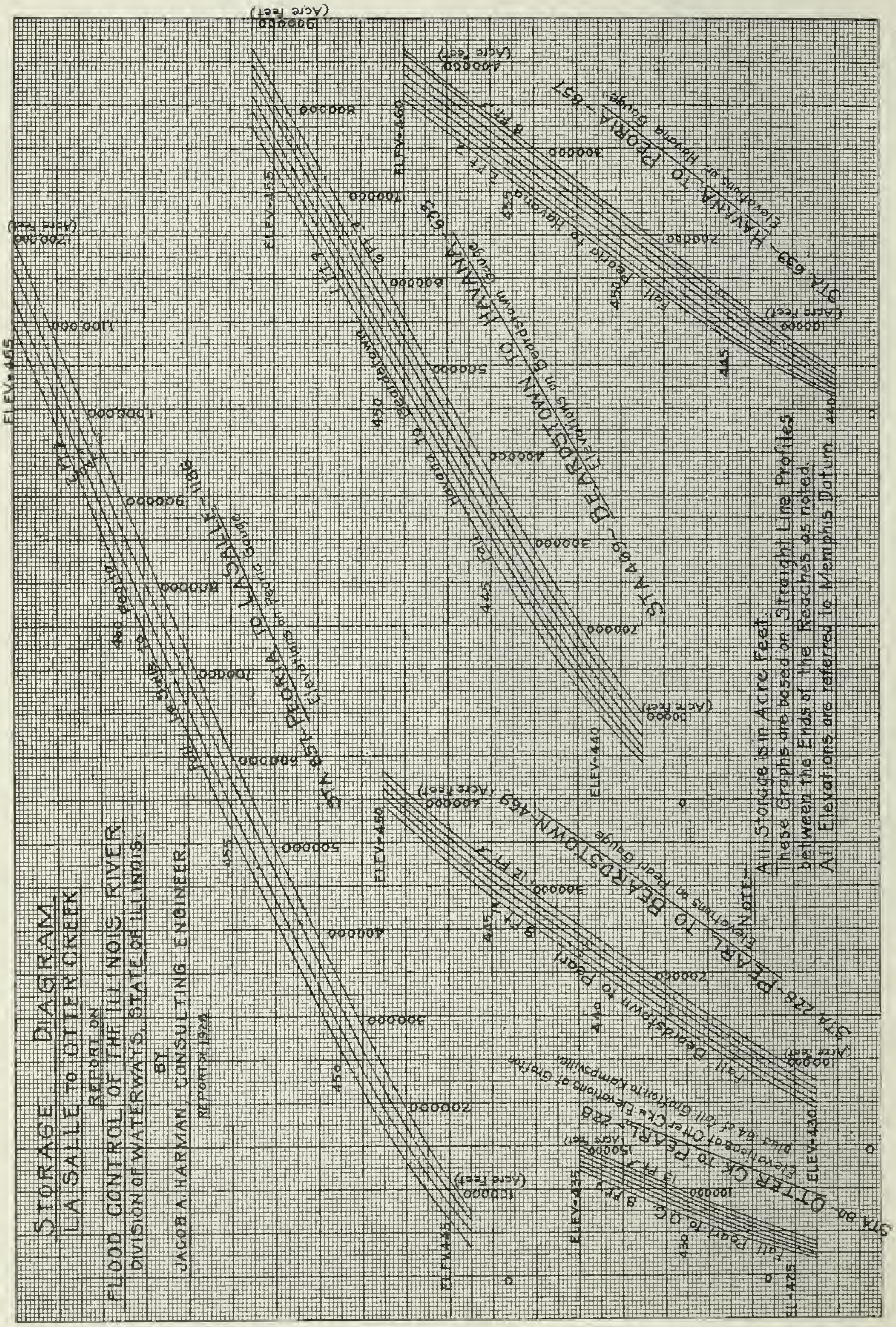

STORAGE DIAGRAM
LA SALLE TO OTTER CREEK
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS.
BY
JACOB A. HARMAN, CONSULTING ENGINEER.
REPORT of 1924
STA 857-PEORIA TO LA SALLE-1156
STA 469-BEARDSTOWN TO HAVANA-633
STA 633-HAVANA TO PEORIA-857
STA 128-PEARL TO BEARDSTOWN-469
STA 80-OTTER CK. TO PEARL-128
Note- All Storage is in Acre Feet.
These Graphs are based on Straight Line Profiles between the Ends of the Reaches as noted.
All Elevations are referred to Memphis Datum.

FIG. No. 18

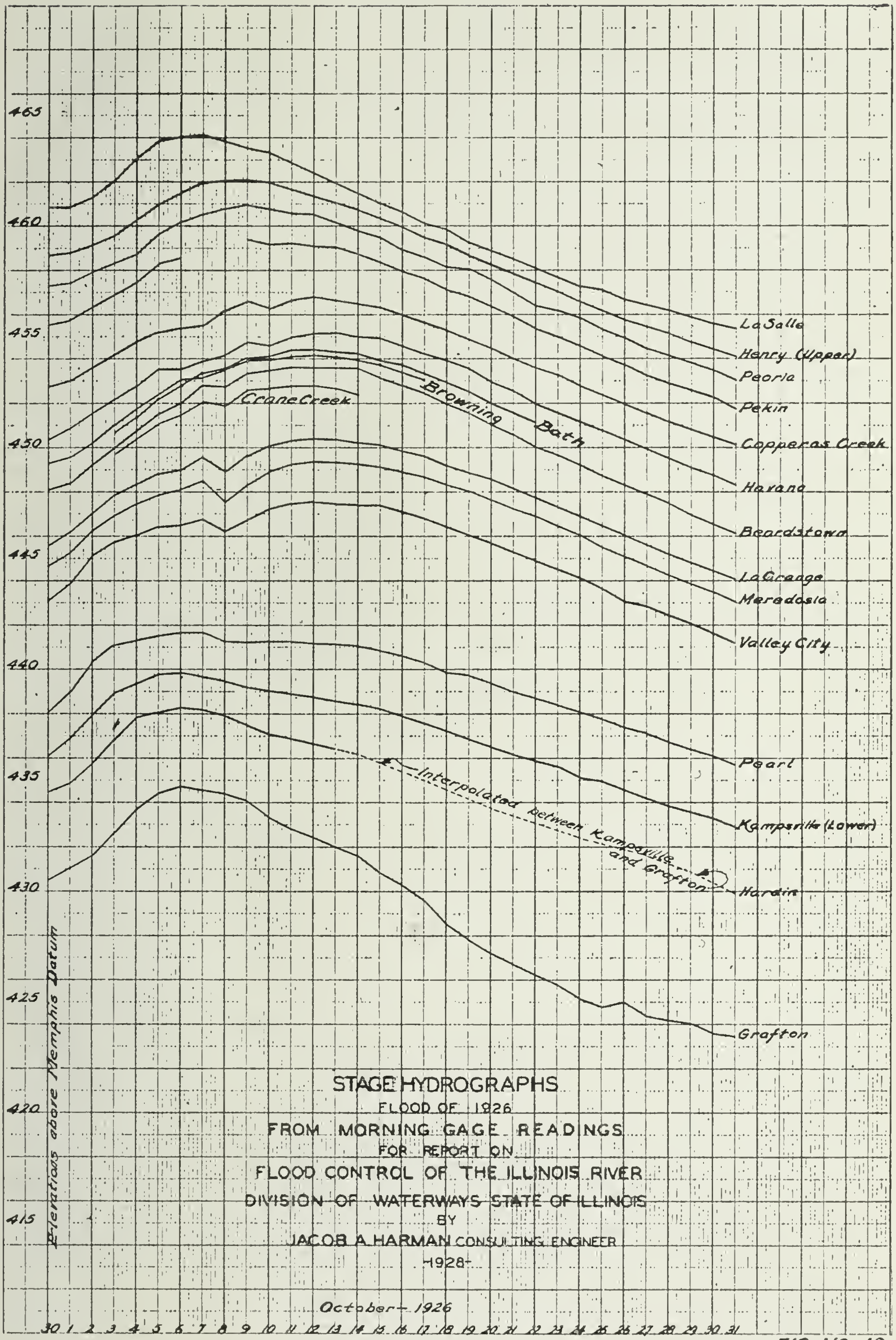

465
460
455
450
445
440
435
430
425
420
415
Elevations above Memphis Datum
LaSalle
Henry (Upper)
Peoria
Pekin
Copperas Creek
Havana
Beardstown
LaGrange
Meredosia
Valley City
Pearl
Kampsville (Lower)
Hardin
Grafton
Crane Creek
Browning
Bath
Interpolated between Kampsville and Grafton
STAGE HYDROGRAPHS
FLOOD OF 1926
FROM MORNING GAGE READINGS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
October-1926
30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

FIG. NO. 19.

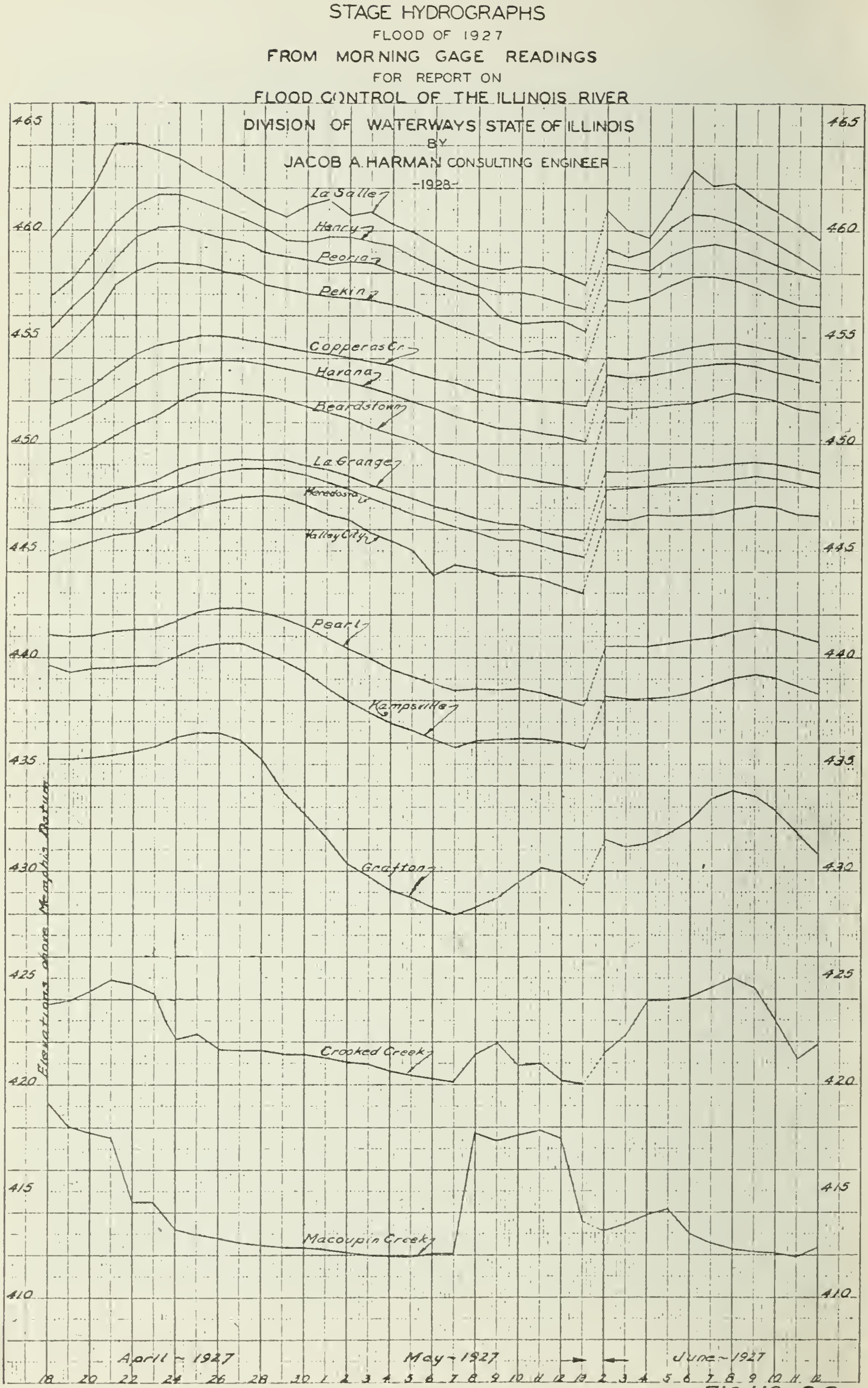

STAGE HYDROGRAPHS
FLOOD OF 1927
FROM MORNING GAGE READINGS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
La Salle
Henry
Peoria
Pekin
Copperas Cr.
Havana
Beardstown
La Grange
Meredosia
Valley City
Pearl
Kampsville
Grafton
Crooked Creek
Macoupin Creek
Elevations above Memphis Datum
465
460
455
450
445
440
435
430
425
420
415
410
April ~ 1927
May ~ 1927
June ~ 1927
18 20 22 24 26 28 30 1 2 3 4 5 6 7 8 9 10 11 12 13 2 3 4 5 6 7 8 9 10 11 12

FIG. NO. 20.

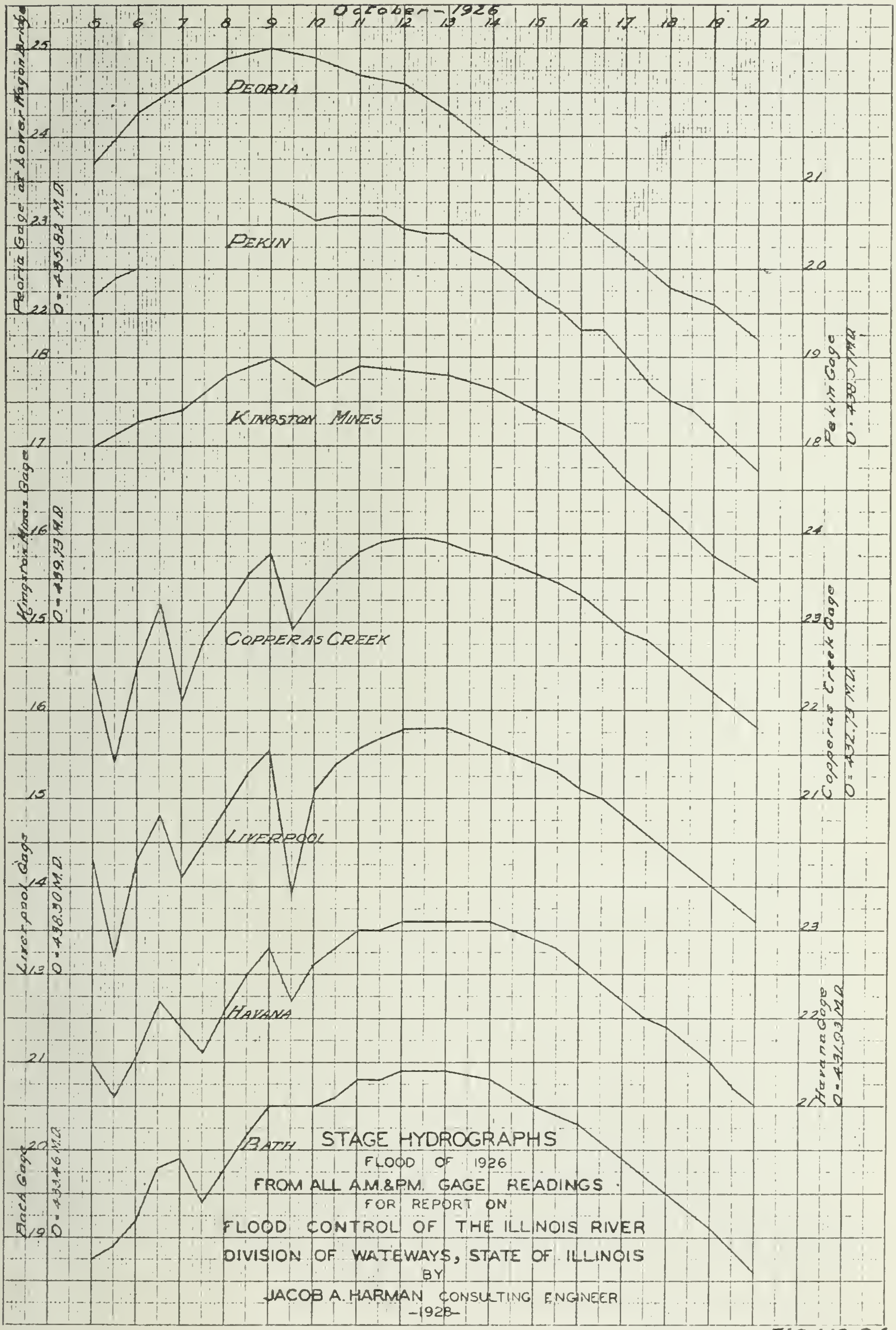

October — 1926
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
PEORIA
PEKIN
KINGSTON MINES
COPPERAS CREEK
LIVERPOOL
HAVANA
BATH
Peoria Gage at Lower Wagon Bridge
O = 435.82 M.D.
Kingston Mines Gage
O = 439.73 M.D.
Liverpool Gage
O = 438.30 M.D.
Bath Gage
O = 433.46 M.D.
Pekin Gage
O = 438.37 M.D.
Copperas Creek Gage
O = 432.73 M.D.
Havana Gage
O = 431.93 M.D.
STAGE HYDROGRAPHS
FLOOD OF 1926
FROM ALL A.M.&P.M. GAGE READINGS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATEWAYS, STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
—1928—

FIG. NO. 21.

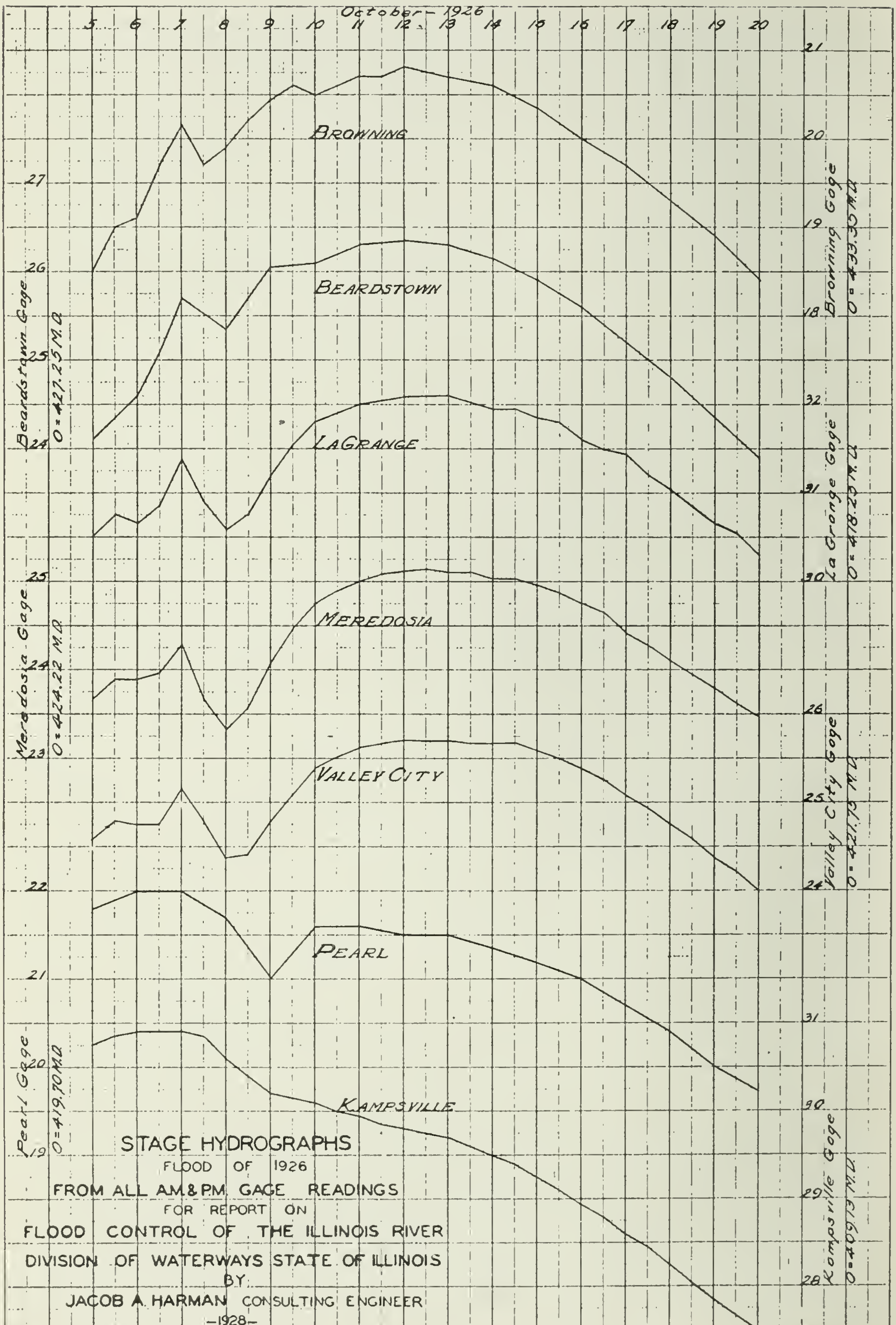

October — 1926
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
BROWNING
BEARDSTOWN
LAGRANGE
MEREDOSIA
VALLEY CITY
PEARL
KAMPSVILLE
Beardstown Gage
0 = 427.25 M.D.
Browning Gage
0 = 433.35 M.D.
La Grange Gage
0 = 418.25 M.D.
Meredosia Gage
0 = 424.22 M.D.
Valley City Gage
0 = 421.75 M.D.
Pearl Gage
0 = 419.70 M.D.
Kampsville Gage
0 = 409.13 M.D.
STAGE HYDROGRAPHS
FLOOD OF 1926
FROM ALL A.M. & P.M. GAGE READINGS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
—1928—

FIG. NO. 22

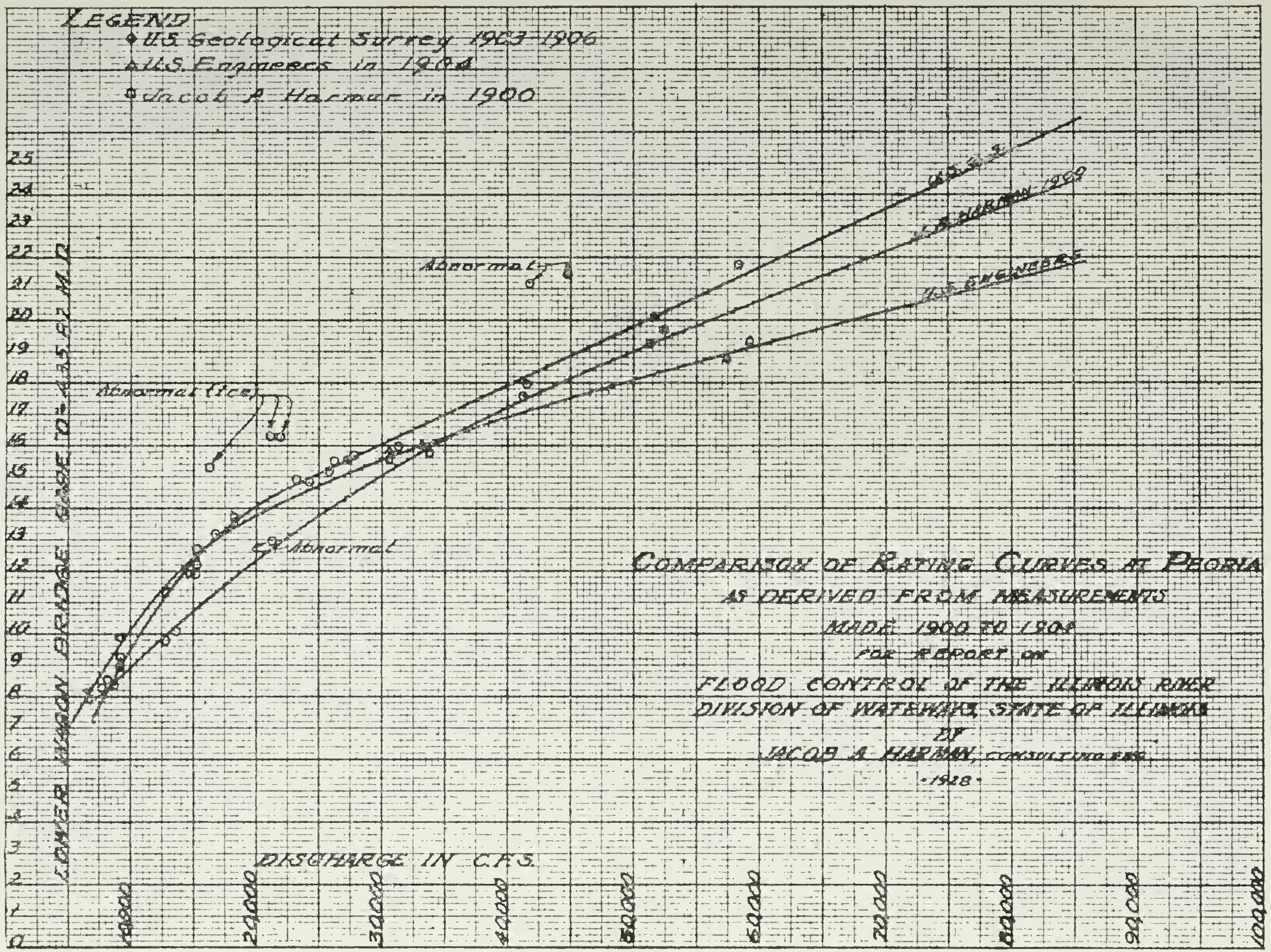

LEGEND
U.S. Geological Survey 1903-1906
U.S. Engineers in 1904
Jacob A. Harman in 1900
Abnormal
Abnormal (Ice)
Abnormal
U.S.G.S.
J.A. Harman 1900
U.S. Engineers
COMPARISON OF RATING CURVES AT PEORIA
AS DERIVED FROM MEASUREMENTS
MADE 1900 TO 1904
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN, CONSULTING ENG.
1928
LOWER WAGON BRIDGE GAGE 0 = 435.52 M.D.
DISCHARGE IN C.F.S.
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000

FIGURE NO. 23.

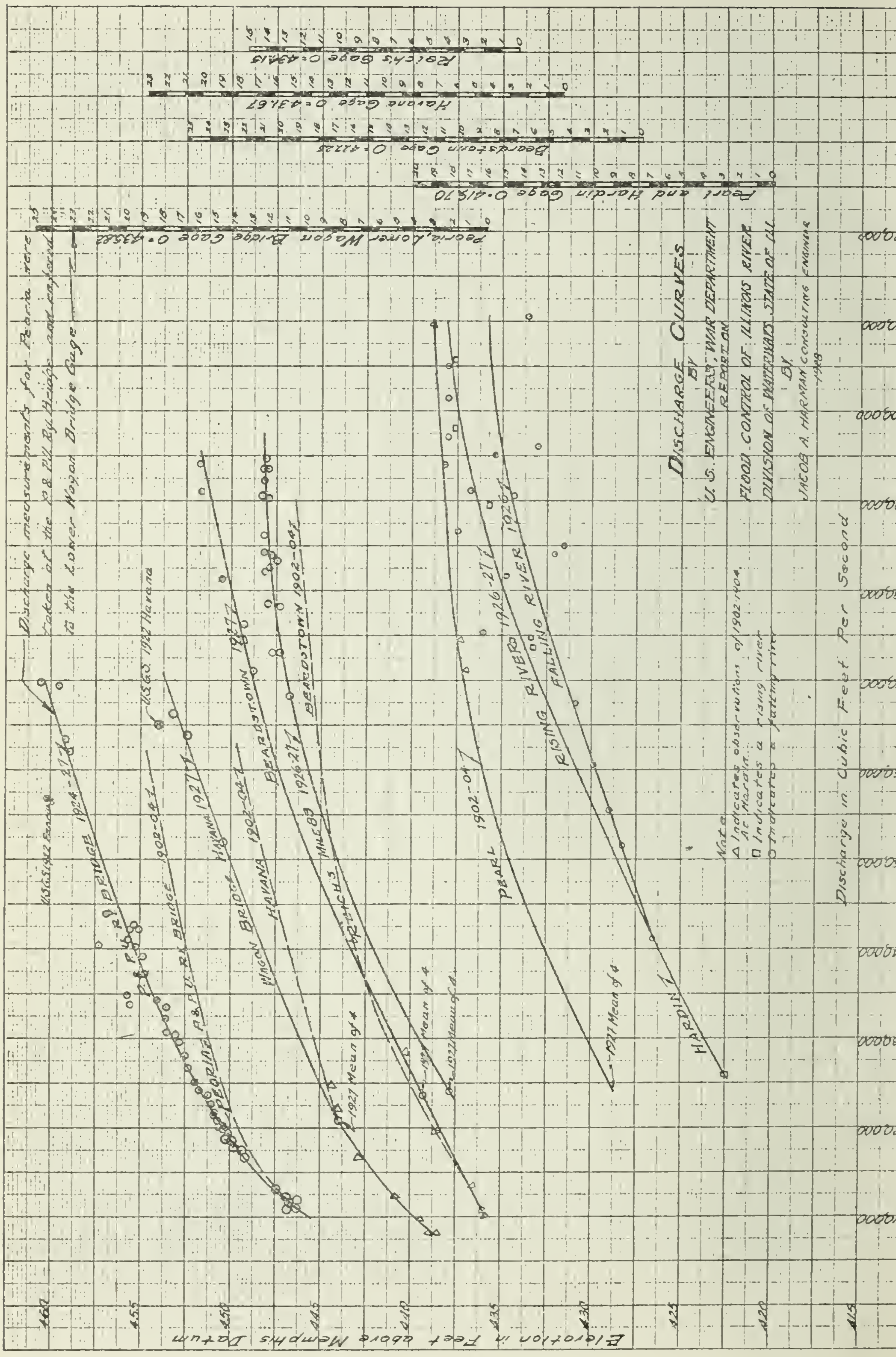

DISCHARGE CURVES
BY
U. S. ENGINEERS, WAR DEPARTMENT
REPORT ON
FLOOD CONTROL OF ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILL.
BY
JACOB A. HARMAN CONSULTING ENGINEER
1928
Discharge in Cubic Feet Per Second
Elevation in Feet above Memphis Datum
Peoria, Lower Wagon Bridge Gage 0=435.82
Pearl and Hardin Gage 0=415.70
Beardstown Gage 0=422.25
Havana Gage 0=431.67
Reichs Gage 0=434.15
RISING RIVER 1926-27
FALLING RIVER 1926-27
PEARL 1902-04
HARDIN
BEARDSTOWN 1902-04
BEARDSTOWN 1927
HAVANA 1902-04
HAVANA 1927
1927 Mean of 4

FIG. NO. 24

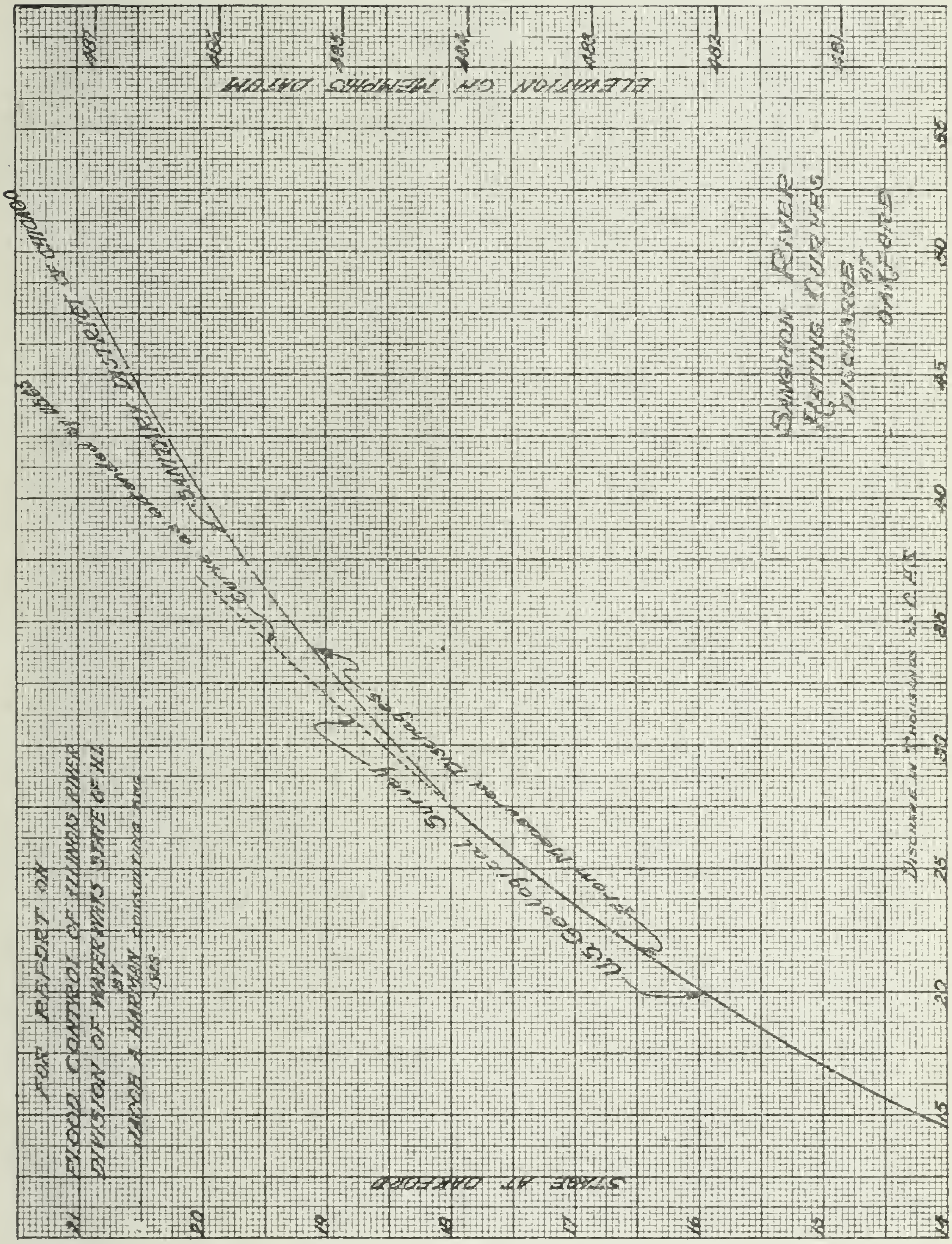


FIGURE NO. 25.

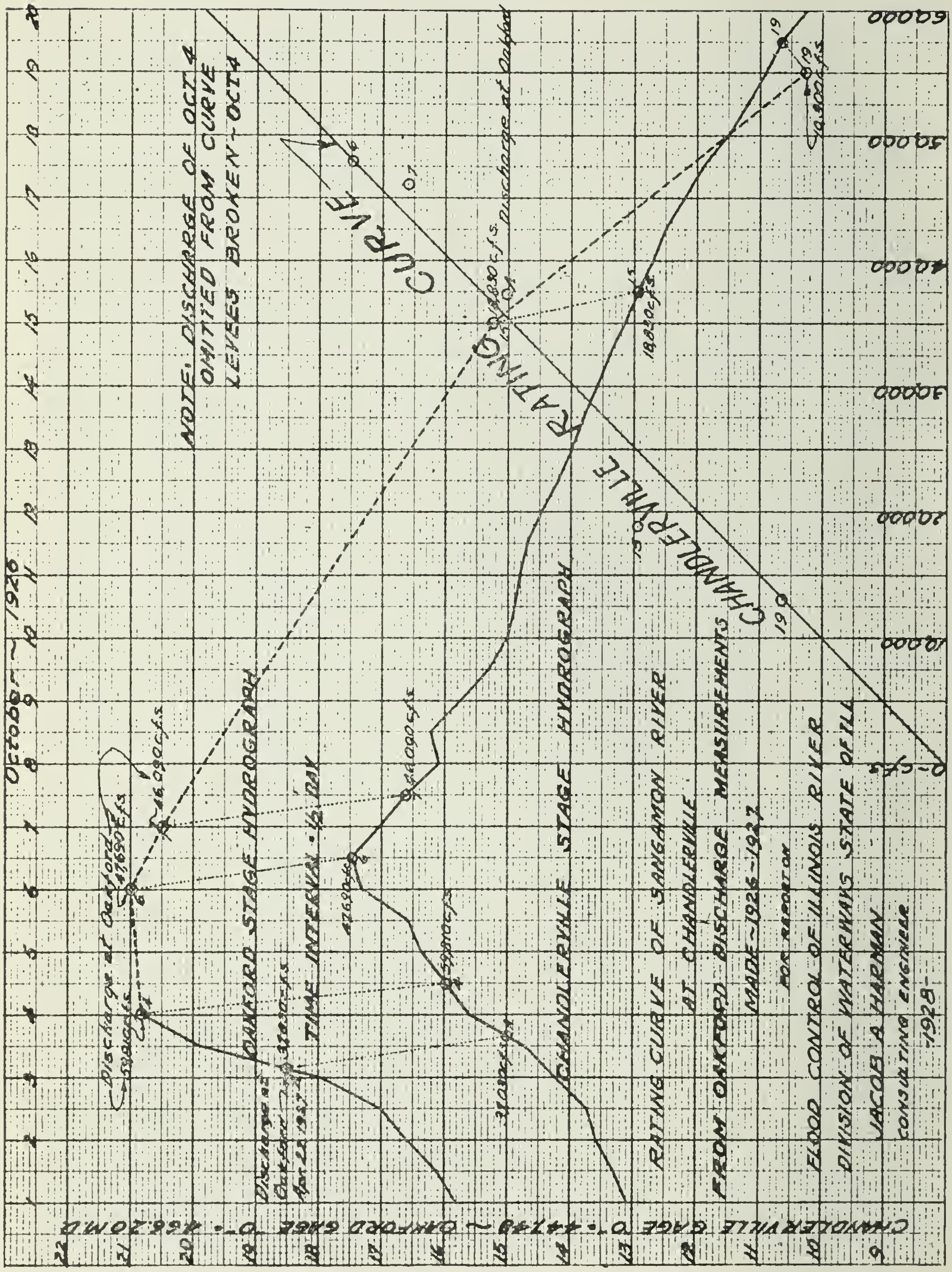

October ~ 1926
NOTE: DISCHARGE OF OCT 4 OMITTED FROM CURVE LEVEES BROKEN - OCT 4
OAKFORD STAGE HYDROGRAPH
TIME INTERVAL - 1/2 DAY
CHANDLERVILLE STAGE HYDROGRAPH
CHANDLERVILLE RATING CURVE
RATING CURVE OF SANGAMON RIVER
AT CHANDLERVILLE
FROM OAKFORD DISCHARGE MEASUREMENTS
MADE - 1926 - 1927
FOR REPORT ON
FLOOD CONTROL OF ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILL
JACOB A HARMAN
CONSULTING ENGINEER
-1928-

FIGURE NO. 26.

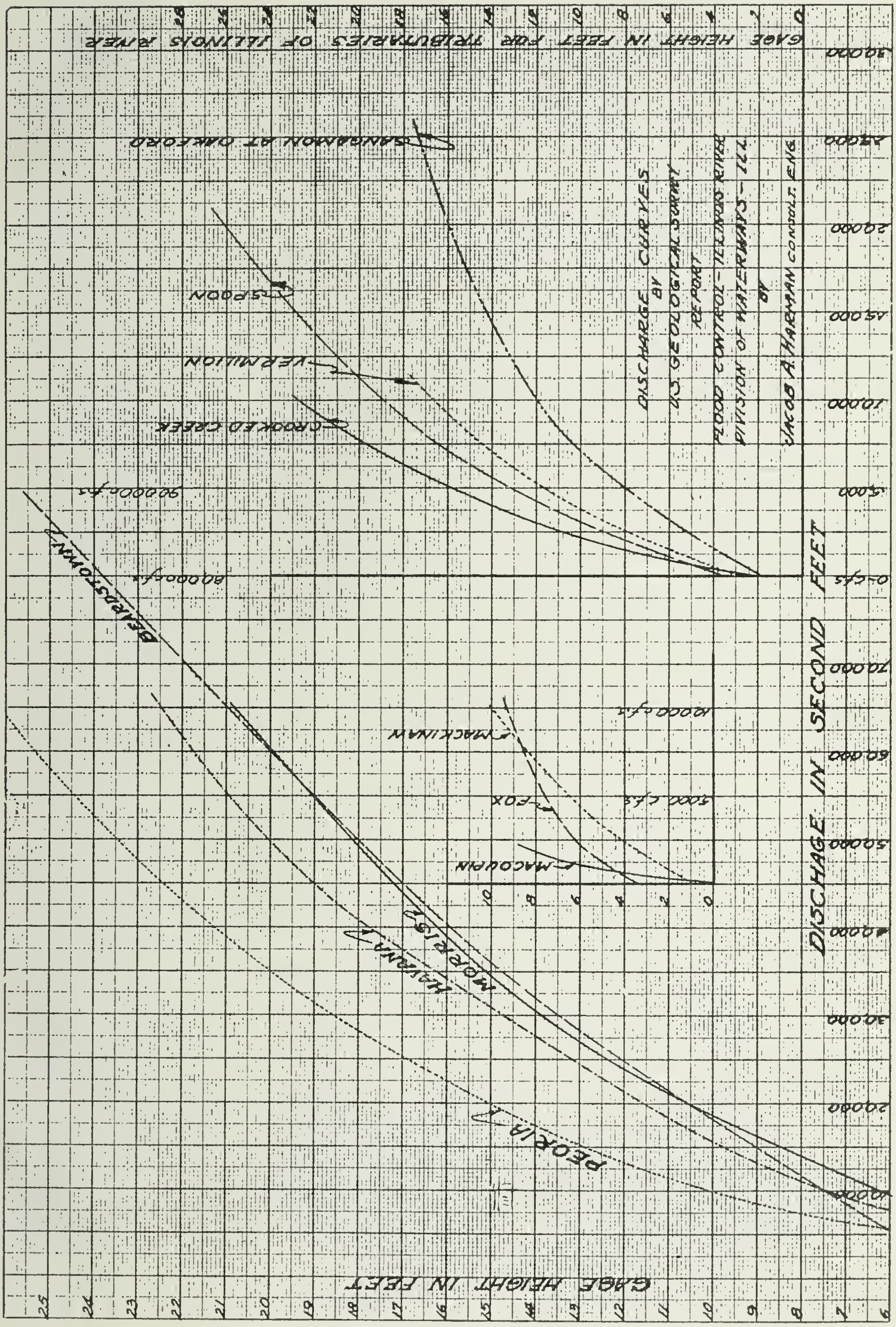

GAGE HEIGHT IN FEET FOR TRIBUTARIES OF ILLINOIS RIVER
SANGAMON AT OAKFORD
SPOON
VERMILION
CROOKED CREEK
DISCHARGE CURVES
BY
U.S. GEOLOGICAL SURVEY
REPORT
FLOOD CONTROL—ILLINOIS RIVER
DIVISION OF WATERWAYS—ILL.
BY
JACOB A. HARMAN CONSULT. ENG.
BEARDSTOWN
MACKINAW
FOX
MACOUPIN
HAVANA
MORRIS
PEORIA
DISCHAGE IN SECOND FEET
GAGE HEIGHT IN FEET

FIG. NO. 27.

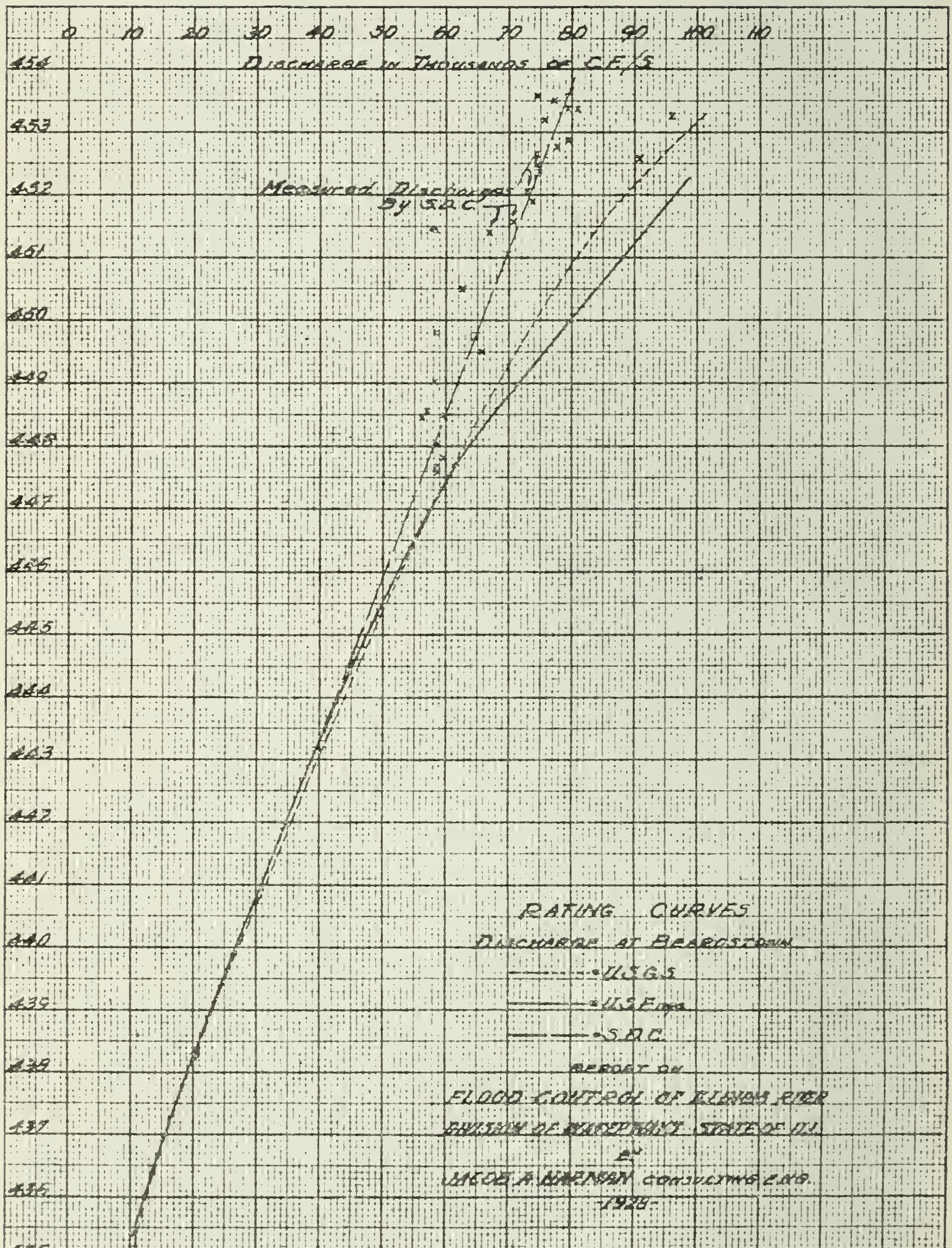

0 10 20 30 40 50 60 70 80 90 100 110
DISCHARGE IN THOUSANDS OF C.F./S
Measured Discharges
By S.D.C.
RATING CURVES
DISCHARGE AT BEARDSTOWN
U.S.G.S
S.D.C.
REPORT ON
1928

FIG. NO. 28

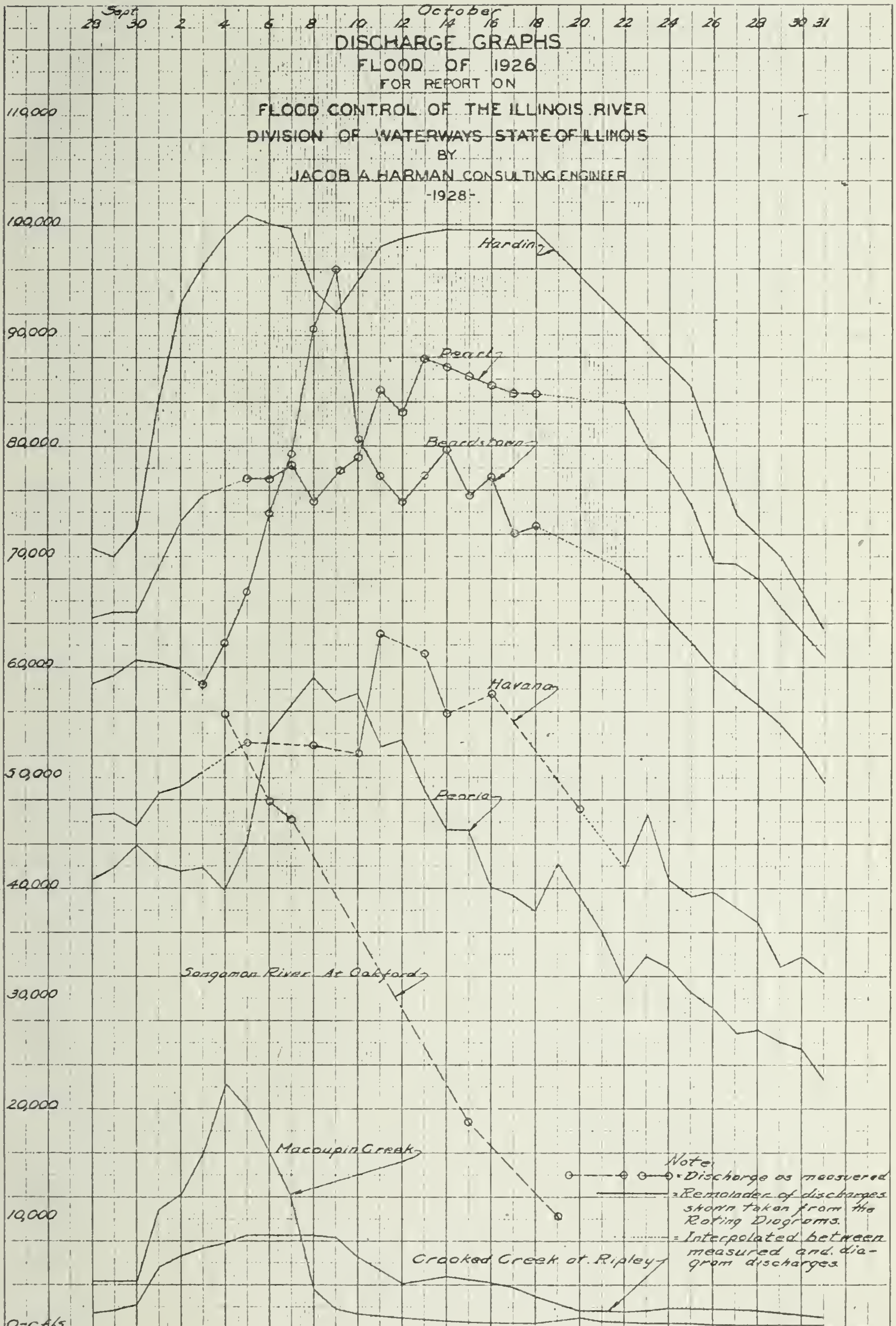

Sept
28 30 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 31
October
DISCHARGE GRAPHS
FLOOD OF 1926
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0-c.f/s
Hardin
Pearl
Beardstown
Havana
Peoria
Sangamon River At Oakford
Macoupin Creek
Crooked Creek at Ripley
Note:
= Discharge as measured
= Remainder of discharges shown taken from the Rating Diagrams.
= Interpolated between measured and diagram discharges

FIG. NO. 29

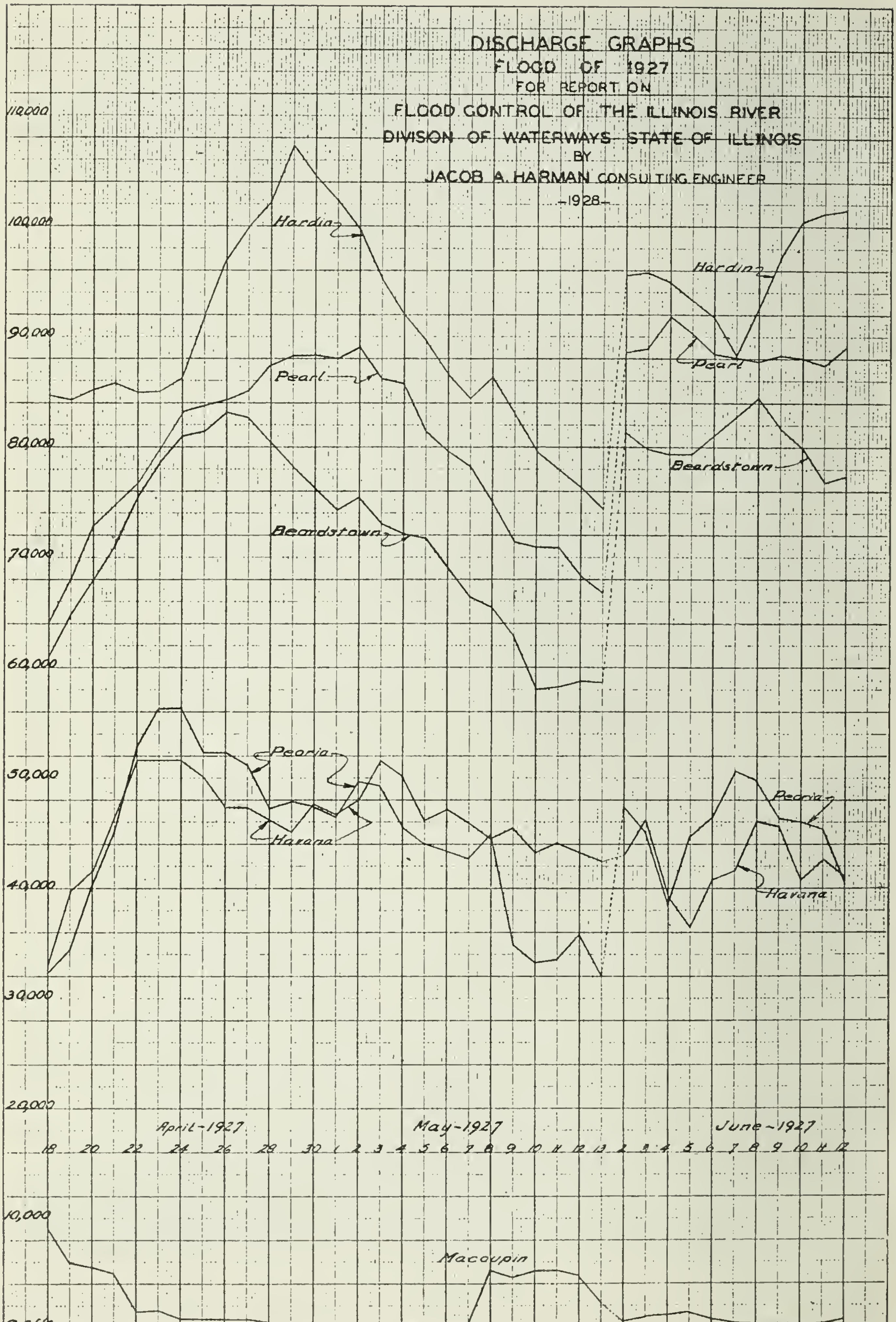
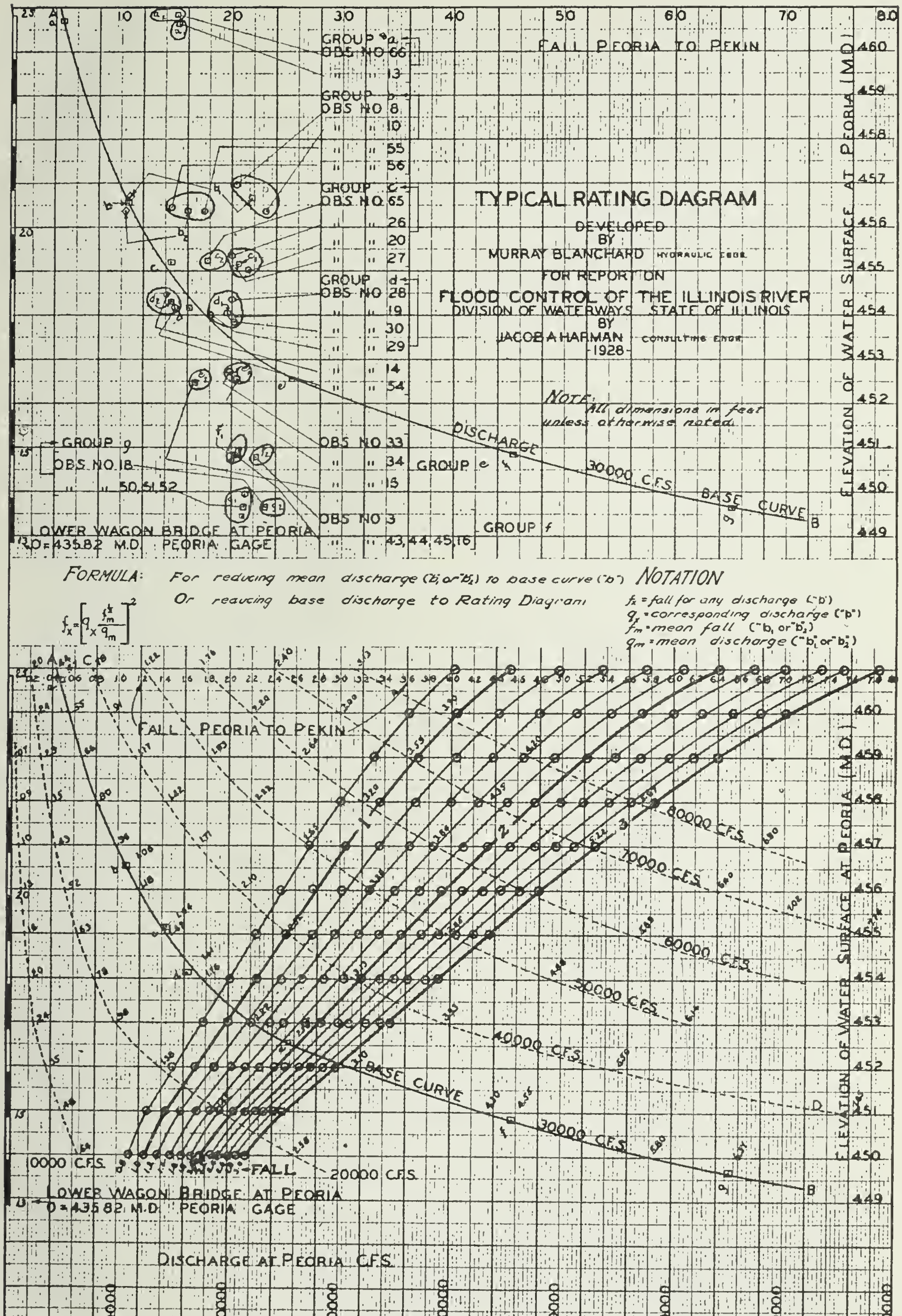

DISCHARGE GRAPHS
FLOOD OF 1927
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0-c.f.s.
Hardin
Pearl
Beardstown
Peoria
Havana
Macoupin
April-1927
May-1927
June-1927
18 20 22 24 26 28 30 1 2 3 4 5 6 7 8 9 10 11 12 13 2 3 4 5 6 7 8 9 10 11 12

FIG. NO. 30


TYPICAL RATING DIAGRAM
DEVELOPED
BY
MURRAY BLANCHARD HYDRAULIC ENGR.
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A HARMAN CONSULTING ENGR.
-1928-
NOTE: All dimensions in feet unless otherwise noted.
FALL PEORIA TO PEKIN
ELEVATION OF WATER SURFACE AT PEORIA (M.D.)
DISCHARGE
30000 C.F.S.
BASE CURVE
LOWER WAGON BRIDGE AT PEORIA
0=435.82 M.D. PEORIA GAGE
FORMULA: For reducing mean discharge ("b1 or "b2) to base curve ("b") Or reducing base discharge to Rating Diagram
$f_x = \left[q_x \frac{f_m^{\frac{1}{2}}}{q_m} \right]^2$
NOTATION
f_x = fall for any discharge ("b")
q_x = corresponding discharge ("b")
f_m = mean fall ("b1 or "b2)
q_m = mean discharge ("b1 or "b2)
DISCHARGE AT PEORIA C.F.S.
10000 C.F.S.
20000 C.F.S.
40000 C.F.S.
50000 C.F.S.
60000 C.F.S.
70000 C.F.S.
80000 C.F.S.

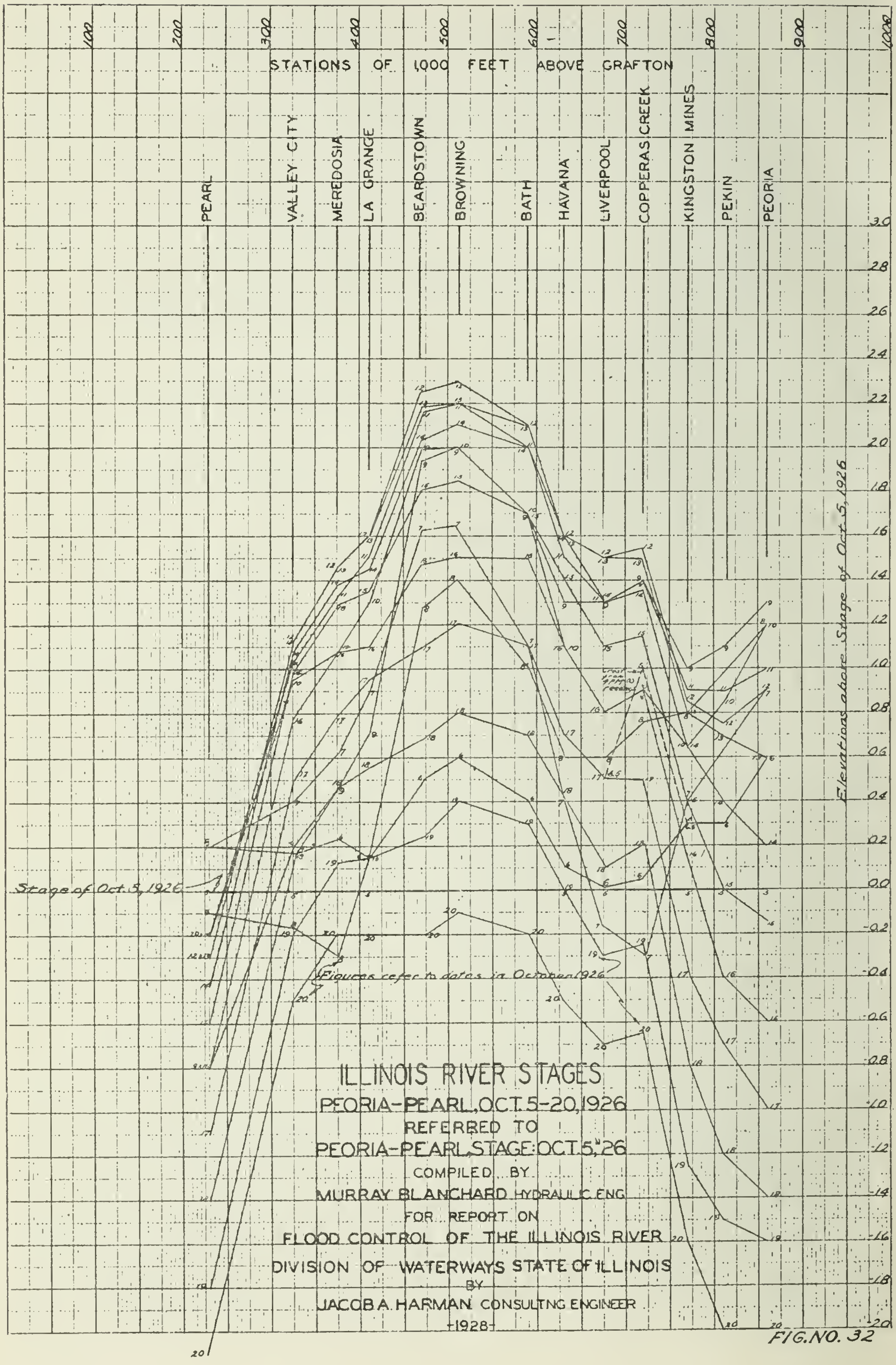

STATIONS OF 1000 FEET ABOVE GRAFTON
100
200
300
400
500
600
700
800
900
1000
PEARL
VALLEY CITY
MEREDOSIA
LA GRANGE
BEARDSTOWN
BROWNING
BATH
HAVANA
LIVERPOOL
COPPERAS CREEK
KINGSTON MINES
PEKIN
PEORIA
Stage of Oct. 5, 1926
Figures refer to dates in October 1926
Elevations above Stage of Oct. 5, 1926
ILLINOIS RIVER STAGES
PEORIA-PEARL, OCT. 5-20, 1926
REFERRED TO
PEORIA-PEARL STAGE OCT. 5, '26
COMPILED BY
MURRAY BLANCHARD HYDRAULIC ENG
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
1928

FIG. NO. 32

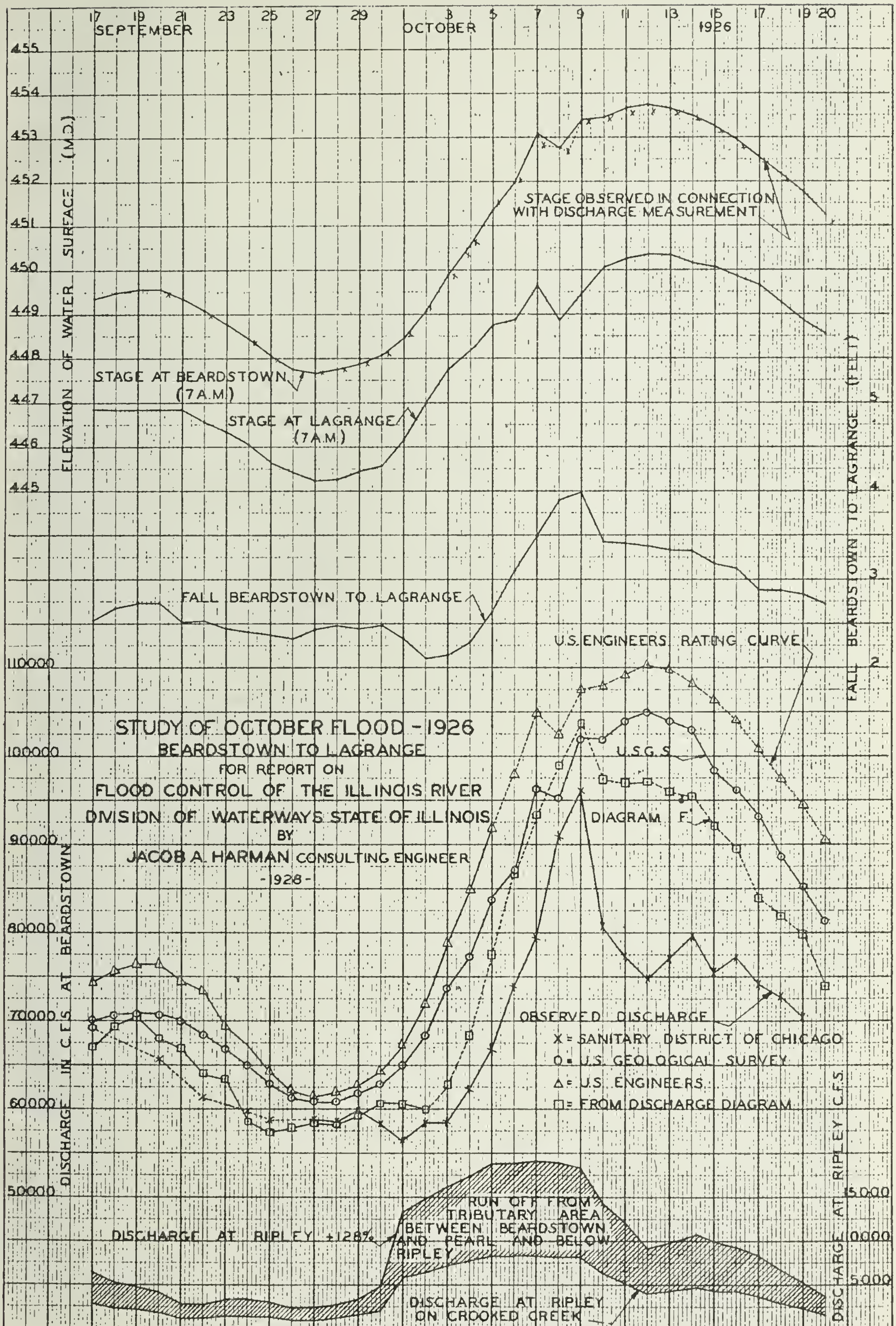

STUDY OF OCTOBER FLOOD - 1926
BEARDSTOWN TO LAGRANGE
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
SEPTEMBER
OCTOBER
1926
ELEVATION OF WATER SURFACE (M.D.)
STAGE OBSERVED IN CONNECTION WITH DISCHARGE MEASUREMENT
STAGE AT BEARDSTOWN (7 A.M.)
STAGE AT LAGRANGE (7 A.M.)
FALL BEARDSTOWN TO LAGRANGE
FALL BEARDSTOWN TO LAGRANGE (FEET)
U.S. ENGINEERS RATING CURVE
U.S.G.S.
DIAGRAM F.
DISCHARGE IN C.F.S. AT BEARDSTOWN
OBSERVED DISCHARGE
X = SANITARY DISTRICT OF CHICAGO
O = U.S. GEOLOGICAL SURVEY
Δ = U.S. ENGINEERS
□ = FROM DISCHARGE DIAGRAM
RUN OFF FROM TRIBUTARY AREA BETWEEN BEARDSTOWN AND PEARL AND BELOW RIPLEY
DISCHARGE AT RIPLEY +128%
DISCHARGE AT RIPLEY ON CROOKED CREEK
DISCHARGE AT RIPLEY C.F.S.

FIG. NO. 33.

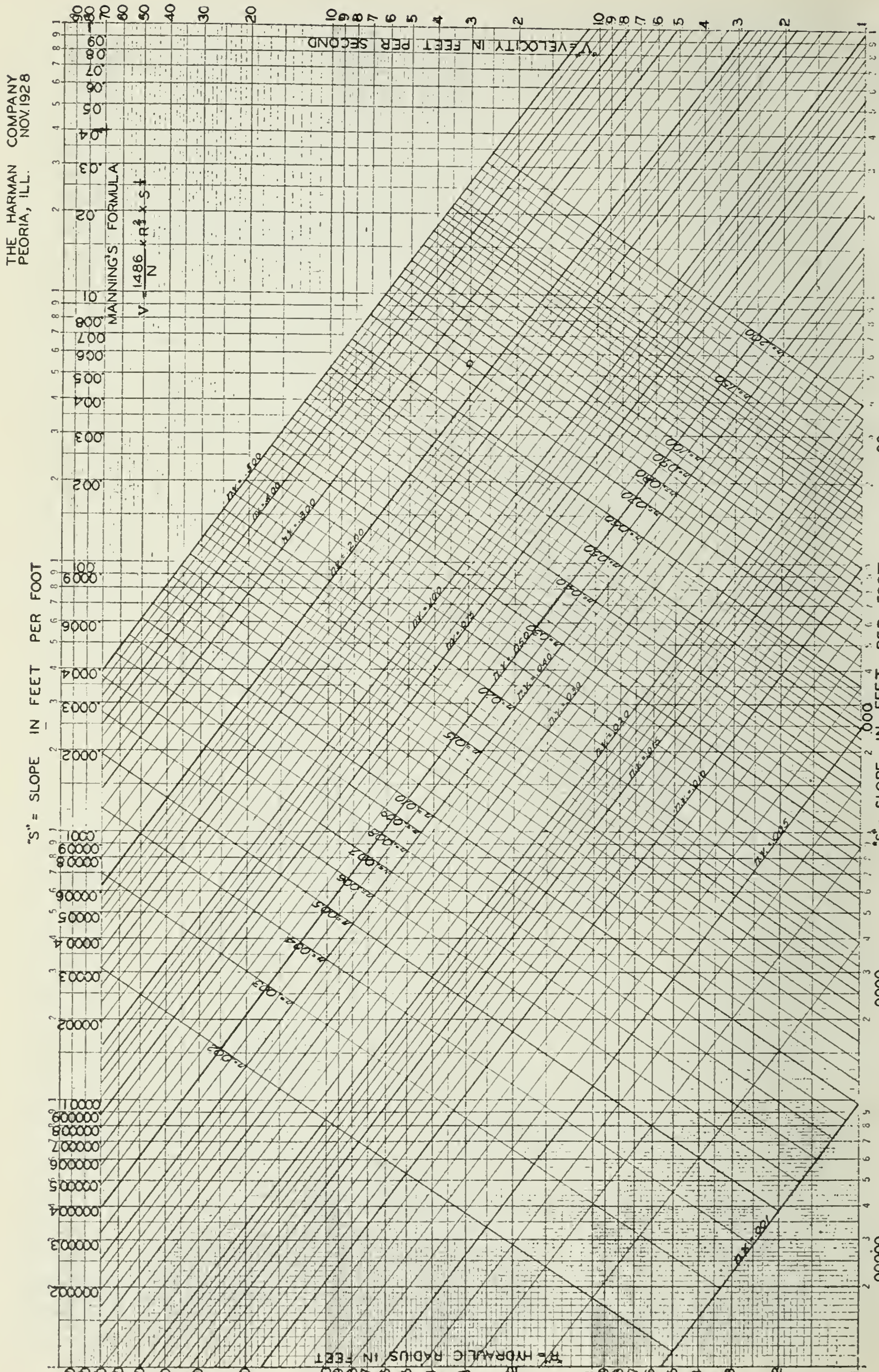
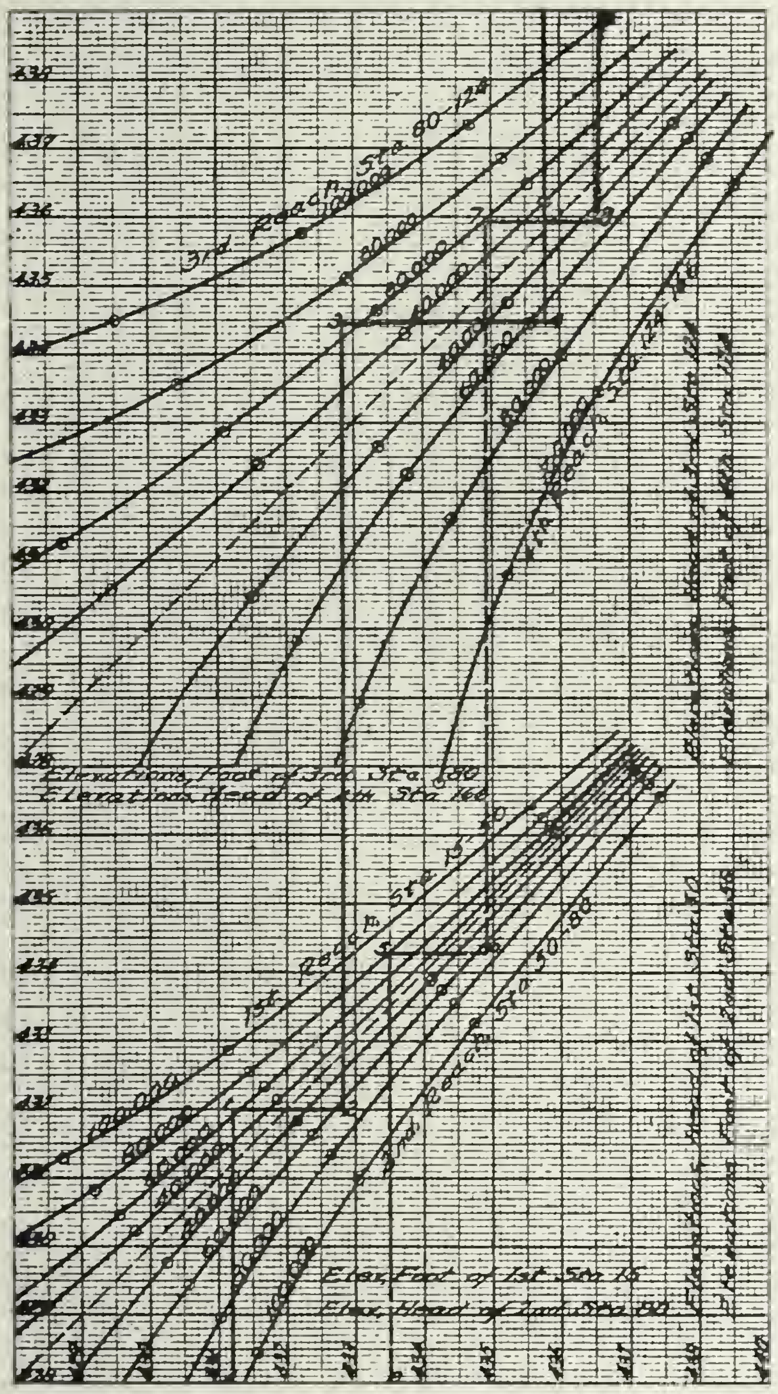

THE HARMAN COMPANY
PEORIA, ILL. NOV. 1928
MANNING'S FORMULA
V = 1486/N × R⅔ × S½
"V" = VELOCITY IN FEET PER SECOND
"S" = SLOPE IN FEET PER FOOT
"R" = HYDRAULIC RADIUS IN FEET

FIG. NO. 34



Elevs on ℄ Reach	Kd	Fall	Elevs Head Reach	Elevs Foot Reach	Fall	Elevs Head Reach	Elevs Foot Reach
Sta 15-50	Q = 40,000 c.f.s.				Q = 60,000 c.f.s.		
430	11,620	0.42	430.21	429.79	0.93	430.47	429.53
432	14,190	0.28	432.14	431.86	0.63	432.32	431.68
436	20,110	0.14	436.07	435.93	0.31	436.16	435.84
Sta 15-50	Q = 80,000 c.f.s.				Q = 100,000 c.f.s.		
430	11,620	1.62	430.81	429.19	2.58	436.43	428.71
432	14,190	1.10	432.55	431.45	1.73	432.87	431.13
436	20,110	0.55	436.28	435.72	0.86	431.29	435.57
Sta 50-80	Q = 40,000 c.f.s.				Q = 60,000 c.f.s.		
430	9,740	0.51	430.25	429.75	1.14	430.67	429.43
432	12,000	0.33	432.17	431.83	0.75	432.38	431.62
434	14,510	0.23	434.12	433.88	0.52	434.26	433.74
437	18,920	0.14	437.07	437.93	0.30	437.15	436.85
Sta 50-80	Q = 60,000 c.f.s.				Q = 100,000 c.f.s.		
430	9,740	2.02	431.01	428.99	3.15	431.57	428.43
432	12,000	1.33	432.67	431.33	2.08	433.04	430.96
434	14,510	0.91	434.46	433.54	1.42	434.71	433.29
437	18,920	0.54	437.27	436.73	0.84	437.42	436.58

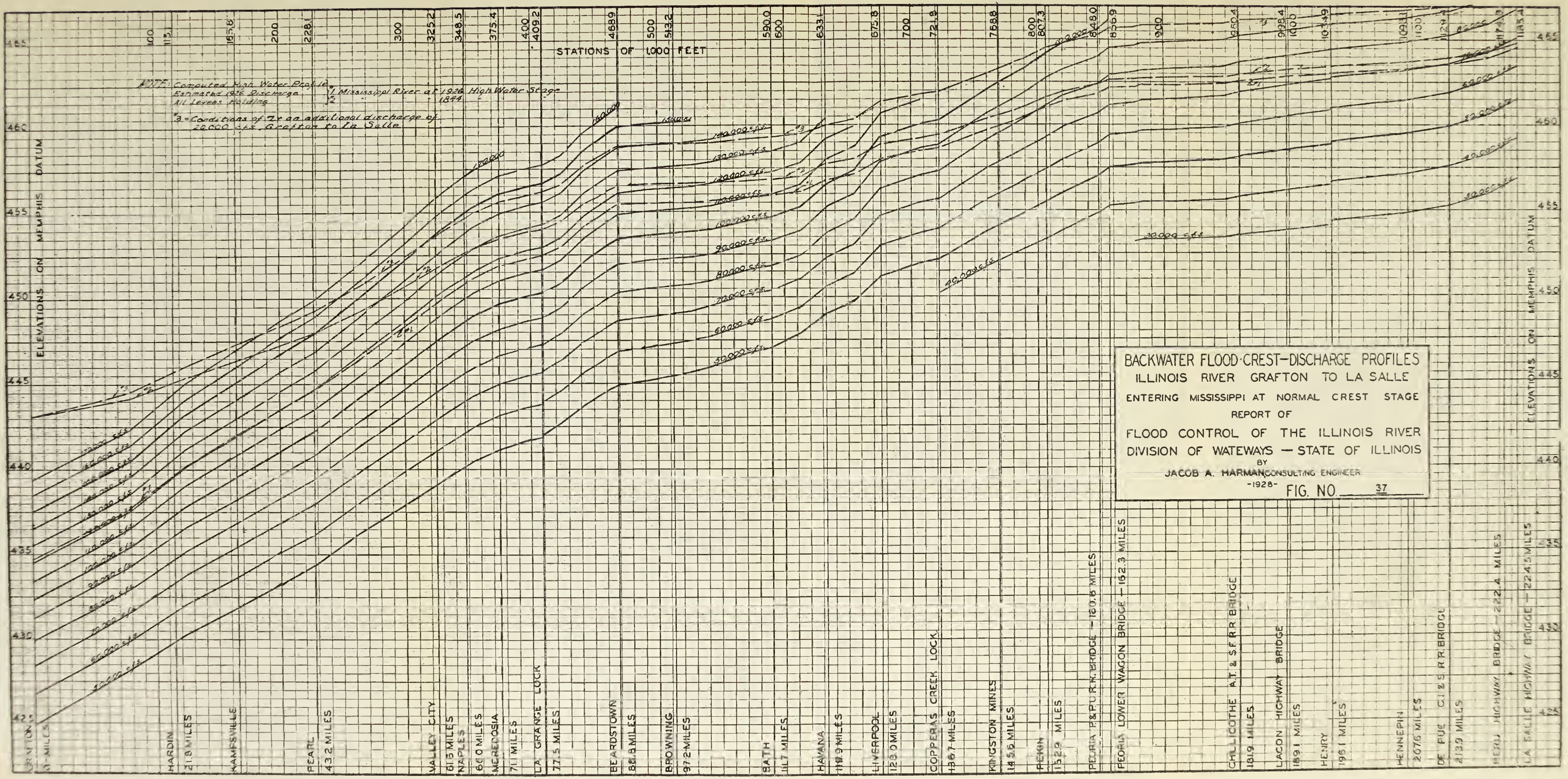
TABLE OF ELEVATIONS
FOR PROFILES SHOWN IN ILLUSTRATIONS

Point	Station	Discharge. Cfs	Water Surface
A	15	65,000	431.20
1	30	65,000	432.00
2	80	65,000	432.82
3	124	65,000	434.43
4	166	65,000	435.78
B	15	100,000	433.50
5	50	80,000	434.28
6	80	70,000	434.91
7	124	60,000	435.94
8	166	50,000	436.57

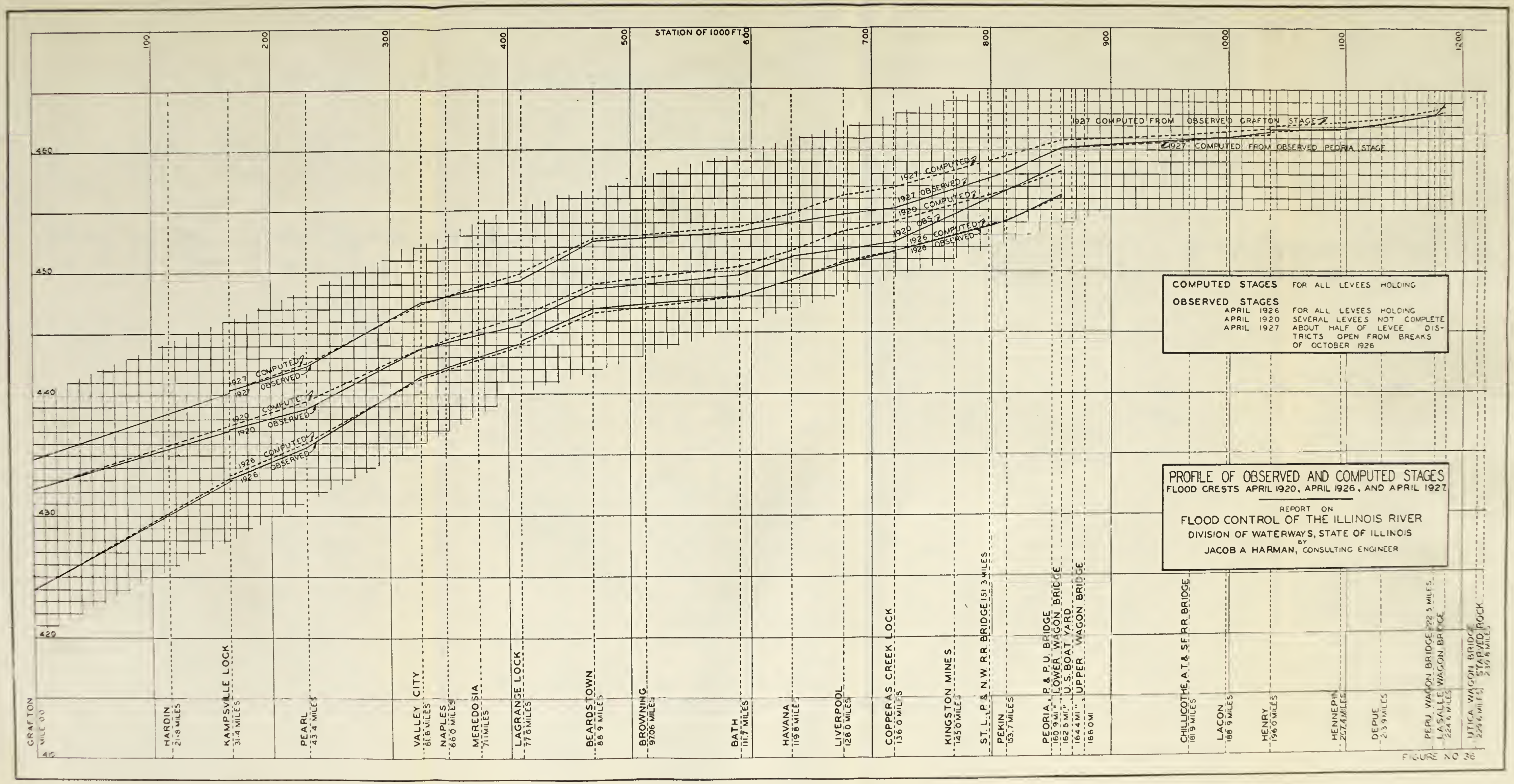
BACKWATER ELEVATIONS
FROM TYPICAL DIAGRAMS

TYPICAL DISCHARGE DIAGRAMS
FOR BACKWATER PROFILE
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-

FIG. NO. 35



STATIONS OF 1000 FEET
NOTE: Computed High Water Profile
Estimated 1926 Discharge
All Levees Holding
*1 Mississippi River at 1926 High Water Stage
*2 1844
*3 = Conditions of *2 + an additional discharge of 20,000 c.f.s. Grafton to La Salle
ELEVATIONS ON MEMPHIS DATUM
BACKWATER FLOOD-CREST-DISCHARGE PROFILES
ILLINOIS RIVER GRAFTON TO LA SALLE
ENTERING MISSISSIPPI AT NORMAL CREST STAGE
REPORT OF
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATEWAYS — STATE OF ILLINOIS
BY
JACOB A. HARMAN CONSULTING ENGINEER
-1928-
FIG. NO. 37
GRAFTON
HARDIN
21.8 MILES
KAMPSVILLE
PEARL
43.2 MILES
VALLEY CITY
61.5 MILES
NAPLES
66.0 MILES
MEREDOSIA
71.1 MILES
LA GRANGE LOCK
77.5 MILES
BEARDSTOWN
88.8 MILES
BROWNING
97.2 MILES
BATH
111.7 MILES
HAVANA
119.9 MILES
LIVERPOOL
128.0 MILES
COPPERAS CREEK LOCK
136.7 MILES
KINGSTON MINES
145.6 MILES
PEKIN
152.9 MILES
PEORIA P.&P.U.R.R. BRIDGE — 160.6 MILES
PEORIA LOWER WAGON BRIDGE — 162.3 MILES
CHILLICOTHE A.T.&S.F. R.R. BRIDGE
181.9 MILES
LACON HIGHWAY BRIDGE
189.1 MILES
HENRY
196.1 MILES
HENNEPIN
207.6 MILES
DE PUE C.I.&S. R.R. BRIDGE
213.9 MILES
PERU HIGHWAY BRIDGE — 222.4 MILES
LA SALLE HIGHWAY BRIDGE — 224.5 MILES



PROFILE OF OBSERVED AND COMPUTED STAGES
FLOOD CRESTS APRIL 1920, APRIL 1926, AND APRIL 1927

REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY
JACOB A HARMAN, CONSULTING ENGINEER

FIGURE NO 38

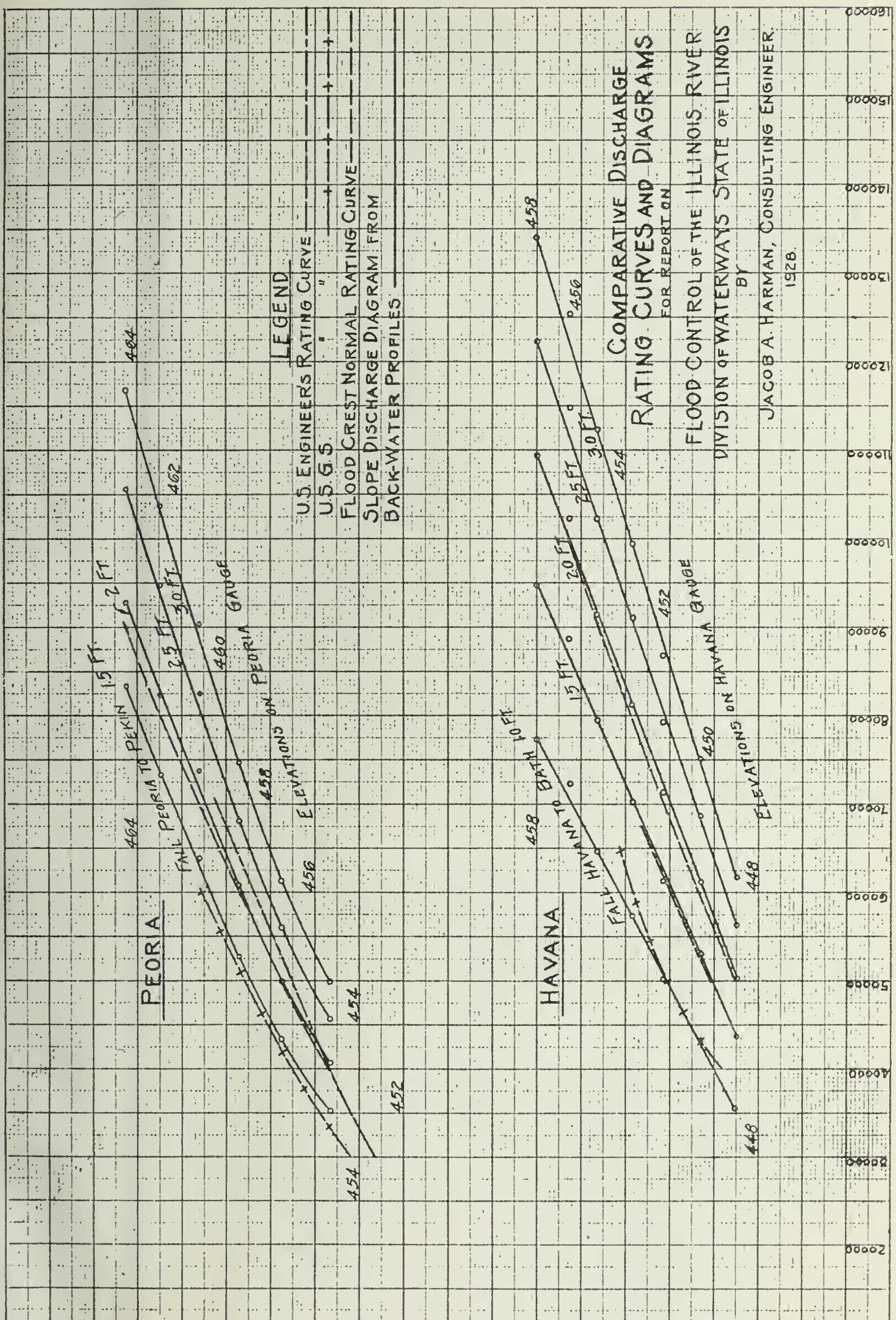

PEORIA
HAVANA
LEGEND
U.S. ENGINEER'S RATING CURVE
U.S.G.S. " "
FLOOD CREST NORMAL RATING CURVE
SLOPE DISCHARGE DIAGRAM FROM
BACK-WATER PROFILES
COMPARATIVE DISCHARGE
RATING CURVES AND DIAGRAMS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A. HARMAN, CONSULTING ENGINEER.
1928.
ELEVATIONS ON PEORIA GAUGE
FALL PEORIA TO PEKIN
ELEVATIONS ON HAVANA GAUGE
FALL HAVANA TO BATH
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
110000
120000
130000
140000
150000
160000

FIG. NO. 38

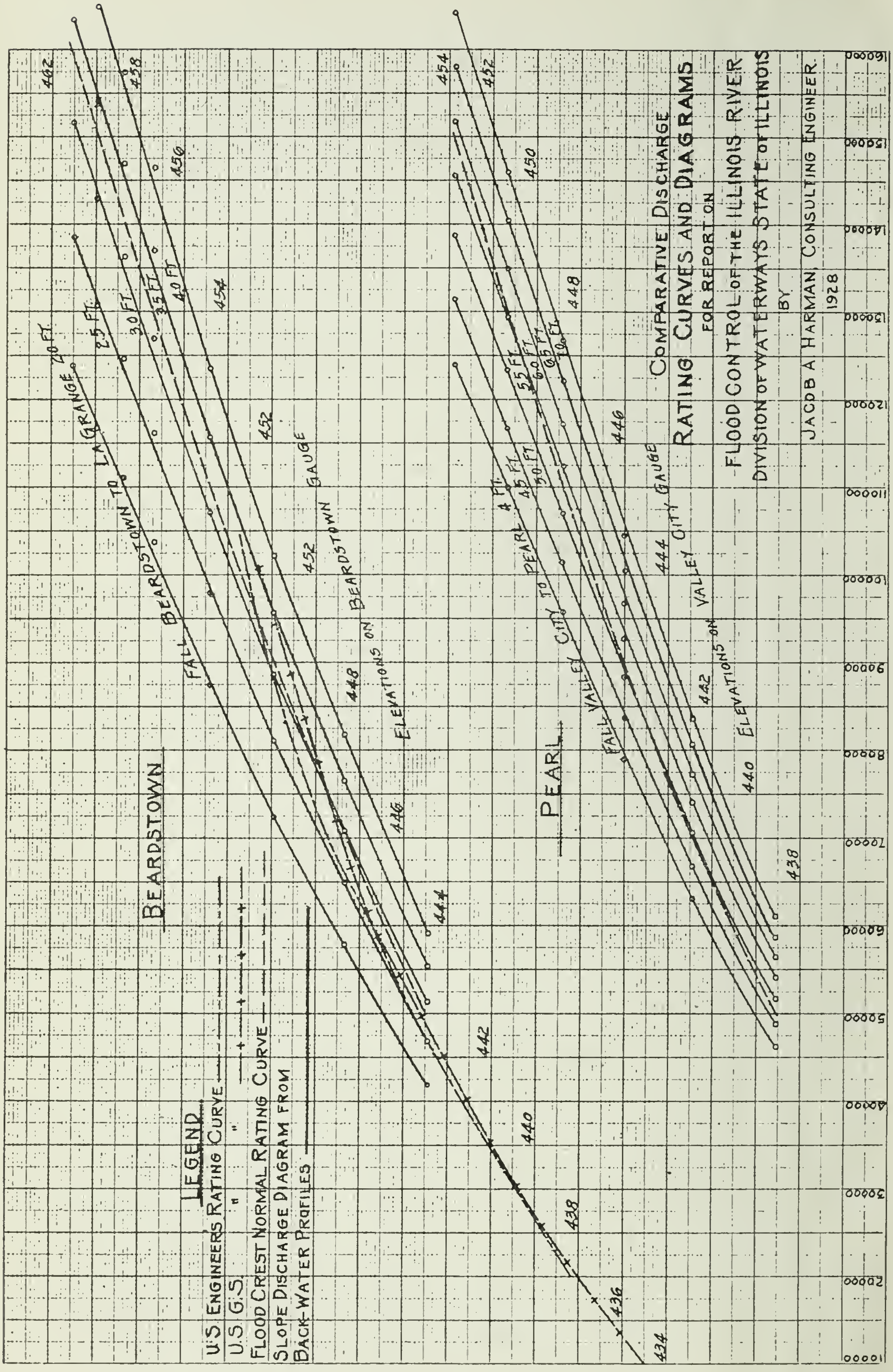
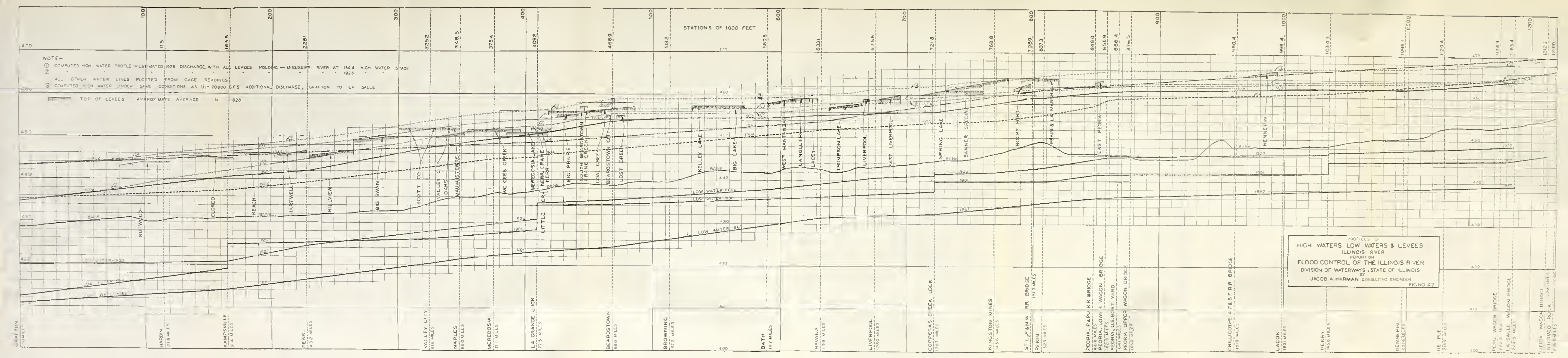
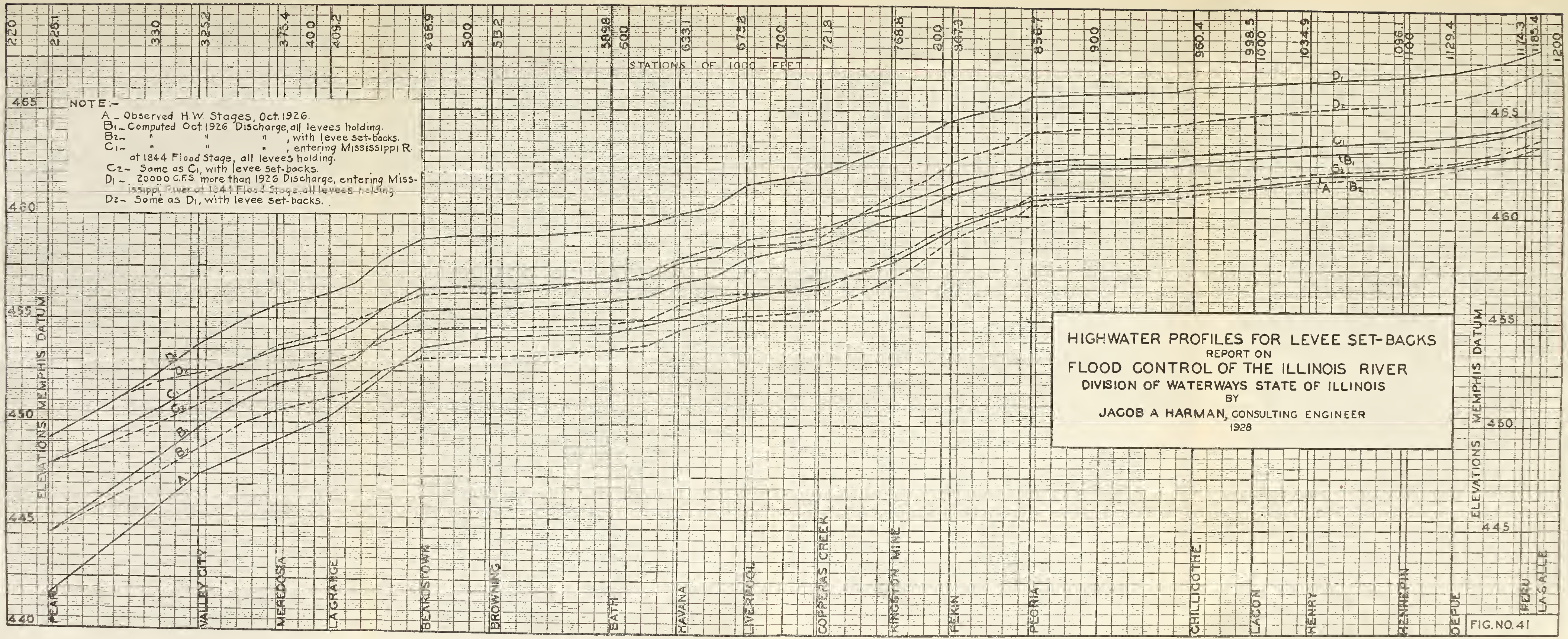

COMPARATIVE DISCHARGE
RATING CURVES AND DIAGRAMS
FOR REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A HARMAN, CONSULTING ENGINEER.
1928
LEGEND
U.S. ENGINEERS RATING CURVE
U.S. G.S. " "
FLOOD CREST NORMAL RATING CURVE
SLOPE DISCHARGE DIAGRAM FROM
BACK-WATER PROFILES
BEARDSTOWN
FALL BEARDSTOWN TO LA GRANGE
ELEVATIONS ON BEARDSTOWN GAUGE
PEARL
FALL VALLEY CITY TO PEARL
ELEVATIONS ON VALLEY CITY GAUGE

FIG. NO. 39

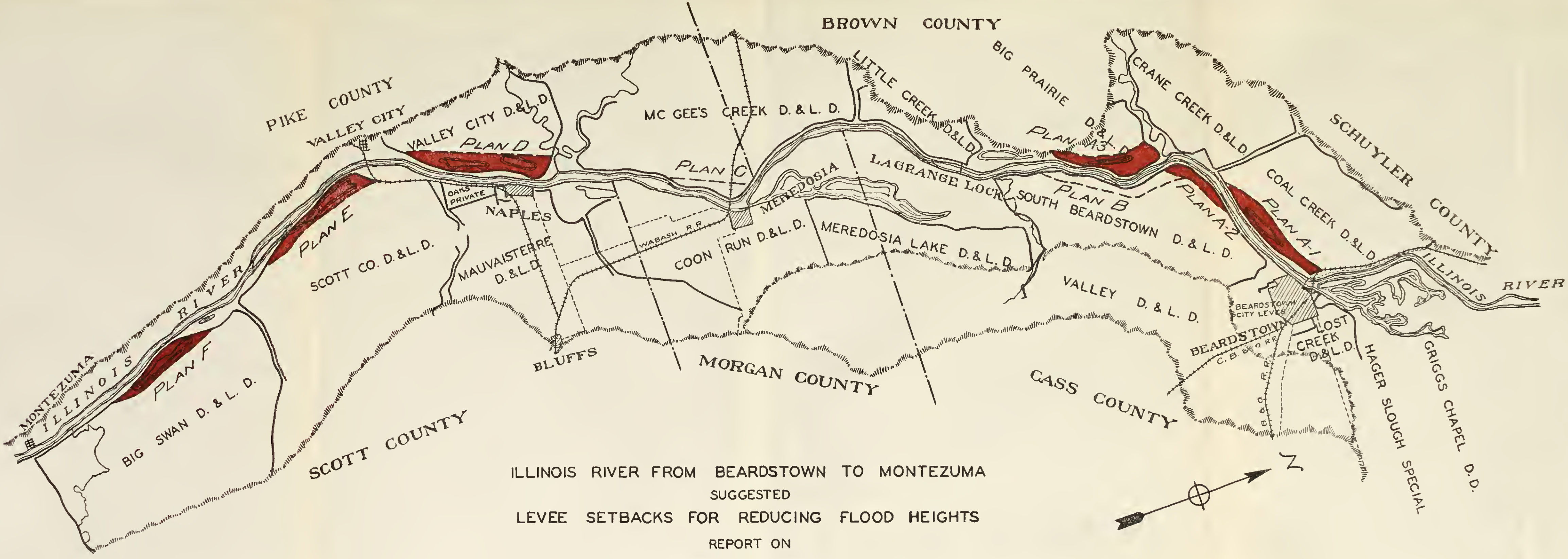


STATIONS OF 1000 FEET
NOTE—
① COMPUTED HIGH WATER PROFILE—ESTIMATED 1926 DISCHARGE, WITH ALL LEVEES HOLDING—MISSISSIPPI RIVER AT 1844 HIGH WATER STAGE
② " " " " " " 1926 " "
ALL OTHER WATER LINES PLOTTED FROM GAGE READINGS.
③ COMPUTED HIGH WATER UNDER SAME CONDITIONS AS ① + 20000 C.F.S. ADDITIONAL DISCHARGE, GRAFTON TO LA SALLE
TOP OF LEVEES APPROXIMATE AVERAGE IN 1928
LOW WATER 1922
LOW WATER 1901
LOW WATER 1867
BANK
NUTWOOD
ELDRED
KEACH
HARTWELL
HILLVIEW
BIG SWAN
SCOTT CO.
VALLEY CITY
OAMS
MAUVAISTERRE
MC GEES CREEK
MEREDOSIA LAKE
LITTLE
KERR
BIG PRAIRIE
SOUTH BEARDSTOWN
COAL CREEK
BEARDSTOWN CITY
LOST CREEK
KELLEY LAKE
BIG LAKE
WEST MATANZAS
LANGELLIER
LACEY
THOMPSON LAKE
LIVERPOOL
EAST LIVERPOOL
SPRING LAKE
BANNER SPECIAL
ROCKY FORD
PEKIN & LA MARSH
EAST PEORIA
HENNEPIN
GRAFTON
HARDIN
KAMPSVILLE
PEARL
VALLEY CITY
NAPLES
MEREDOSIA
LA GRANGE LOCK
BEARDSTOWN
BROWNING
BATH
HAVANA
LIVERPOOL
COPPERAS CREEK LOCK
KINGSTON MINES
ST. L. P. & N.W. BRIDGE
PEKIN
PEORIA, P&PU R.R. BRIDGE
PEORIA, LOWER WAGON BRIDGE
PEORIA, U.S. BOAT YARD
PEORIA, UPPER WAGON BRIDGE
CHILLICOTHE A.T.& S.F. R.R. BRIDGE
LACON
HENRY
HENNEPIN
DE PUE
PERU WAGON BRIDGE
LA SALLE WAGON BRIDGE
UTICA WAGON BRIDGE
STARVED ROCK
PROFILES OF
HIGH WATERS LOW WATERS & LEVEES
ILLINOIS RIVER
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY
JACOB A HARMAN CONSULTING ENGINEER
FIG NO. 42



HIGHWATER PROFILES FOR LEVEE SET-BACKS
REPORT ON
FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS STATE OF ILLINOIS
BY
JACOB A HARMAN, CONSULTING ENGINEER
1928

FIG. NO. 41



ILLINOIS RIVER FROM BEARDSTOWN TO MONTEZUMA

SUGGESTED

LEVEE SETBACKS FOR REDUCING FLOOD HEIGHTS

REPORT ON

FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS - STATE OF ILLINOIS

BY

JACOB A. HARMAN - CONSULTING ENGINEER

1928

Scale of Miles

1 3/4 1/2 1/4 0 1 2

FIG. NO. 40

PART II—FLOOD CONTROL—MISSISSIPPI AND OHIO RIVERS.

SECTION I—DISCUSSION BY THE DIVISION OF WATERWAYS.

DESCRIPTION.

The Mississippi River borders the State of Illinois on the West for a distance of 600 miles. Its watershed in Illinois, excluding the Illinois River, contains about 20,000 square miles.

Its largest tributary, except the Illinois River, is the Rock River, into which drain the Pecatonica, the Kishwaukee and the Green Rivers. The Rock River flows into the Mississippi at Rock Island about 100 miles south of the Wisconsin State line and drains with its tributaries about 5,310 square miles in Illinois and 5,510 square miles in Wisconsin. Its second largest tributary is the Kaskaskia with a drainage area of 5,830 square miles entering the Mississippi about 60 miles south of St. Louis. The Big Muddy is another large tributary with a drainage area of 2,390 square miles. Smaller tributaries of importance are the Henderson and Edwards Rivers.

The Ohio River forms the southern boundary of Illinois for a distance of 133 miles, and from the Ohio northward its tributary, the Wabash, borders the State on the east a distance of nearly 200 miles. The watershed of the Ohio in Illinois contains about 11,600 square miles of which 8,770 square miles drain by way of the Wabash and its tributaries the Embarrass, the Little Wabash and the Skillet Fork Rivers. The remaining 2,800 square miles are drained by the Saline and Cache Rivers, Bay Creek and other small tributaries.

FLOOD CONTROL ALONG THE MISSISSIPPI RIVER.

Flood control along the tributaries of the Mississippi previously mentioned, has consisted largely of channel straightening of the main stream with the necessary ditches to carry tributary drainage. In a few cases only have levees been constructed.

On the other hand, many levee districts have been formed in the bottom lands immediately adjacent to the Mississippi. Here the bottom lands extend back in some places several miles from the main stream and the building of levees early appeared an economical means of preventing overflow.

Levee building on the Mississippi started first at Cairo, where protection of city property appeared more urgent than did the protection of agricultural land, which then could be obtained at cheap prices. By 1880 farm land had risen in value so that the larger tracts of bottom

land favorably situated could be economically protected by means of levees. Between 1880 and 1900, ten or more levee districts were formed and levees built protecting some 250,000 acres. After 1900 steady progress was made in levee building, land rose in value and the smaller tracts of land were reclaimed until today there exist more than 50 levee districts and over 500,000 acres, out of a total of 600,000 acres of Mississippi River bottom land, protected by levees.

The reclamation of overflowed land and the building of levees made good progress until about 1920, when land values reached their high point due to war inflation. The drop in land values which occurred a short time later caused a cessation in formation of new districts and land reclamation since that date has consisted largely of necessary improvements to existing structures.

Few districts along the Mississippi River have complete drainage. Usually a gravity outlet only at the lower end of the district is provided for the removal of water which collects behind levees. This means that during flood periods drainage is more or less obstructed or water from the river backs up the outlet, overflowing some of the low lands. In only a few cases have pumping plants been installed to completely drain the land.

Many levees have been built along the Mississippi River in cooperation with the Federal Government. The accompanying map, Figure No. 43, shows those levees built with Federal aid and those built by the districts alone. This map shows all levee districts on both sides of the Mississippi River between Cairo and Rock Island.

FLOOD CONTROL ALONG THE OHIO RIVER.

The land along the north bank of the Ohio River is comparatively high and there are few areas subject to overflow. The only exceptions to this are at three points, namely, one near Cairo where bottom lands are protected by levees from overflow of both the Ohio and Mississippi Rivers, one in a bend of the river in the southeast part of Massac County and the third near Shawneetown just south of the mouth of the Wabash River. Neither of the latter two areas has been leveed. Shawneetown, however, is protected by a levee built by the State of Illinois, 1913 to 1915, at a cost of $49,000.00.

FLOODS OF THE MISSISSIPPI AND OHIO RIVERS.

Floods of the Mississippi River have occurred in various years but no particular flood has been a maximum for the full length of the stream. Maximum floods for different reaches of the Mississippi have occurred in different years. The flood of April, 1927, is the highest known flood for the 50 mile stretch between Cairo and Cape Girardeau. North from Cape Girardeau, a distance of 170 miles to Grafton, the flood of 1844 is a maximum. North from Grafton as far as Keithsburg, a distance of 220 miles, the flood of 1851 has never been exceeded. For the 55 mile stretch between Keithsburg and Rock Island the high water of 1892 is a maximum and northward to the Wisconsin State line the high water of 1880 is a maximum. The reason for these floods having been a maximum for a short stretch of the river only is, of course, the

fact that excessive rainfall causing maximum floods, occurs over a portion of the watershed only.

Figure No. 44, attached to this report, is a profile showing flood crest elevations for various Mississippi River floods. This drawing shows also the location and elevations of the zeros of all river gauges.

THE FLOOD OF 1927.

The flood of 1927 crested at Cairo April 20th at a gauge height of 56.4, which was 2.8 feet higher than the crest of 1922 and the greatest flood of record as far north as the vicinity of Cape Girardeau. From Cape Girardeau north, as far as St. Louis, it was the highest flood since 1903. Levees were broken as far north as Chester and several drainage and levee districts containing about 100,000 acres were flooded, destroying crops and damaging property. Under the emergency flood relief act of 1927, the State of Illinois expended the sum of $557,983.00 in restoring the levees of these districts.

PICTURE NO. 7.

South Quincy Drainage and Levee District near Quincy, Ill.
Break in Levee April 24th, 1929.

THE FLOOD OF 1929.

A flood of considerable magnitude occurred in March and April, 1929, over the Mississippi as far north as Keokuk. For the stretch of the river between St. Louis and Keokuk this flood was the highest since 1903, and at one point, Quincy, Illinois, it reached a stage higher than that of 1903, and within one foot of the record flood of 1851. The levees of two districts near Quincy were broken and about 25,000 acres of bottom land flooded.

PROTECTION FROM FUTURE FLOODS OF THE MISSISSIPPI AND OHIO RIVERS.

The flood control of the Mississippi River above the mouth of the Ohio is a problem demanding much study. As is the case with the Illinois River, levees have been built encroaching upon the flood plane, thereby raising flood heights. A levee three feet above the greatest flood of record, which occurred before levees were built, should not be relied upon to furnish complete protection.

There exists also the possibility that the maximum flood of record may be exceeded. A complete study of all the storm data now available should be made to determine the probability of the occurrence of several storms over the watershed in such a way as to cause the simultaneous cresting of several important tributaries.

PICTURE NO. 8.

South Quincy Drainage and Levee District. View of Break about 24 hours after preceding picture was taken.

Stream gauging records for the upper Mississippi should be made available by publication for several points so that proper rating curves may be made for use in flood control studies.

Floods in the Ohio River occur more frequently than in the Mississippi, but for the lower stretch of the river near Cairo and Mound City, flood heights from the Ohio alone are not excessive, the maximum stages being caused by the back-water effect of maximum floods of the Mississippi. A study should be made of Ohio River floods as effecting existing levee heights and the outflow of important tributaries.

The flood control of both the Mississippi and Ohio Rivers demands co-operation with the Federal Government and perhaps also with the several State Governments. The State of Indiana is especially con-

cerned in flood control of the Wabash River and any plan for flood control of this river should be a joint plan.

FLOOD PROTECTION OF THE CITY OF CAIRO AND VICINITY.

The flood protection for the City of Cairo, Mound City, Mounds and neighboring territory is believed to be the most important problem demanding attention at the present time. These cities are situated between the Mississippi and the Ohio and are affected by floods in both rivers. They are centers of population and industry where protection to life and property is needed more than at many other localities.

HISTORY OF THE CITY OF CAIRO.

Situated at the junction of the Mississippi and Ohio Rivers, the earliest French explorers found the site of the present City of Cairo an ideal camping and trading post. Similarly the actual founding of Cairo

PICTURE NO. 9.

Degognia Drainage and Levee District on Mississippi River about 50 miles north of Cairo—High Water of 1927. Sandbagging Levee During a Storm.

in 1818 as a privately owned enterprise was the result of careful consideration of the advantages of its geographical location.

The slow growth of Cairo in the period of thirty-six years from 1818 to 1854 was due to financial reverses and lack of interest of its citizens in a private enterprise in which they had no voice or authority. In 1857 Cairo was incorporated by an Act of the Illinois legislature as a city with a right to be governed by its own people, and from then on its growth was steady, until today we find a modern city of about 15,000 population.

BARGE LINE TERMINAL.

At the head of year around navigation on the Mississippi River Cairo has become an important barge line terminal and point for the

transfer of freight from railroad to barge and from barge to railroad. The barge line terminal represents an inveestment of about $500,000 and is one of the largest floating docks in the country. Two principal barge lines use this dock, the Mississippi-Warrior service, operated by the Federal Government through its Inland Waterways Corporation, and the American Barge line, which is privately owned. Private lines also use it for their own freight. The volume of barge line business is increasing from year to year. The number of tons of freight handled through the Cairo Terminal during 1927 and 1928 is shown below:

SOUTHBOUND.

	1927.	1928.
Grain	18,347 tons	91,113 tons
Merchandise	103,867 tons	124,938 tons
Total	122,214 tons	216,051 tons

NORTHBOUND.

	1927.	1928.
Bauxite Ore	112,550 tons	162,829 tons
Merchandise	197,389 tons	167,611 tons
Total	309,939 tons	330,440 tons
Grand Total	432,153 tons	546,491 tons

RAILROAD AND INDUSTRIAL CENTER.

Cairo was early recognized as the logical commercial center for this territory. In 1855 the Illinois Central Railroad was completed into the city and since then three other railroads have been built. Cairo's importance as a railroad and shipping center has made it an ideal location for various industries, especially those dealing in lumber and grain. The annual lumber business amounts in volume to 150 million feet valued at some $15,000,000. There are several grain elevators in the city and a large volume of grain business is handled. In addition to the lumber and grain business, Cairo is the center of the wholesale business in other commodities for the territory within a radius of 200 miles.

HISTORY OF LEVEE BUILDING.

When Cairo was first settled little was known concerning past floods. The settlers saw only a strip of low flat ground of a sandy nature, an ideal location to them commercially because of the boat traffic which passed up and down the two rivers.

The building up of the present modern system of levees has been a gradual process. The following paragraphs concerning the early history of levee construction at Cairo are taken from a "Report on Flood and Drainage Problems in City of Cairo, Illinois, and Cairo Drainage District" by C. E. Smith and Company, Consulting Engineers, St. Louis, Mo., published by the City of Cairo in 1922:

"The first levee in Cairo was built in 1828 and surrounded a hotel near the site of the present Halliday House. By 1843 a levee encircling some 800 acres of land had been completed by the land trust. Being of light construction and low height, it had little effect towards preventing overflows in the flood of 1844. Later when additional funds became available, repairs, additions and extensions were made but continuing damage was experienced in succeeding floods. In the 1849 flood the west levee, along the Mississippi, was

cut for a distance of 1,625 feet. During the June flood of 1858 it again gave way and caused the last flood that ever submerged Cairo.

"In 1862, through neglect, erosion set in on the Ohio levee, between Eighth and Fourteenth Streets, and necessitated expensive repairs. In 1875 radical changes in the channel of the Mississippi occurred and a section of the Mississippi levee, near 33rd Street, was undermined and abandoned. An entirely new section on what is now called New Levee Street was constructed in 1876 to replace it. After 1875 we learn of little trouble with levees until the flood of 1912 when both the Mississippi and Ohio levees in the drainage district north of Cairo were breached and Cairo cut off for days from outside communication by rail although the city itself was not inundated and water traffic continued. One year later, in 1913, when the record flood of 54.8 feet occurred, heroic measures were required to keep the water out of the city, but as in every flood since 1858 the people won. Not once in 65 years from 1858 to 1922 has Cairo been under water."

In 1914 and 1915 through appropriations by the City of Cairo and the State and Federal Governments the levees were again enlarged. The work done by the State at this time consisted of a concrete wall, 1.61 miles in length along the Ohio River levee of the city. In the spring of 1927 a record flood occurred which reached a stage of 56.4 or within 3.6 feet of the top of the levee and the water was kept out of the city and the drainage district only by constant effort and the expenditure of a large sum of money. In 1927 and 1928 the State of Illinois, under its emergency flood relief act, repaired the damage done to the city levee and that of the Cairo Drainage District. At the present time (1929) the Federal Government is raising and enlarging the Mississippi River levee of the City of Cairo and of the Cairo Drainage District and is planning to raise and strengthen the Ohio River levee.

COST OF LEVEES.

The cost to date of the levee system protecting the City of Cairo and the Cairo Drainage District is approximately as follows:

Expended by various agencies previous to 1913 (estimated)	$1,500,000.00
Federal Government, 1913-1914	250,000.00
City of Cairo, railroads and drainage district by taxation, 1913-1914	400,000.00
State of Illinois, 1913-1914	250,000.00
State of Illinois, 1915	25,000.00
City of Cairo and drainage district repairs to levees, 1916-1928 about	50,000.00
State of Illinois, 1927-1928, levee repairs	347,000.00
Total	$2,822,000.00

The above does not include the amount spent by the Federal Government in 1928-29 in raising the Mississippi River levee nor sums spent for revetment work by the Federal Government nor the money spent by various agencies in fighting floods.

NECESSITY OF ADDITIONAL PROTECTION.

A great catastrophe and the loss of many lives would doubtless have resulted had the levees protecting the City of Cairo given way during the flood of 1927. That this catastrophe was narrowly averted is the belief of everyone having knowledge of the situation existing at that time. It required the expenditure of about $140,000 and all available labor resources of the city, the drainage district, the railroads and the various large industries to prepare and place along the levees the hundreds of thousands of sand bags required to check slides and "well up" the numerous sand boils inside the levees which were a constant menace.

The flood reached a height of 59.3 at the Cache River, over-topping the levee for long stretches by a foot or more and requiring the building of timber bulkheads to hold out the water. Near the crest of the flood the Dorena crevasse occurred down the river just north of New Madrid, and the flood waters finding a new outlet, were prevented from reaching the crest of 58 or 58.5 at Cairo gauge predicted by the Weather Bureau. A height of 58.5 at Cairo gauge using the same river slope would have meant a height of 61.4; at Cache River levee, the Mississippi and Cache River levees of the Cairo Drainage District would have been over-topped, and it is probable that the cross-levee between the district and the City of Cairo would also have given way, thus flooding the city.

It is evident, therefore, that the flood of 1927 was kept out of the City of Cairo only through the failure of the levee system below that point. Such a flood occurring under present conditions, with the Dorena crevasse repaired, might prove disastrous.

The repairing of the Cache River levee by the State of Illinois and the raising of the Mississippi River levee of the Cairo Drainage District by the Federal Government were previously mentioned as improvements accomplished since the flood of 1927. These improvements, and other improvements planned by the Federal Government, while of great importance are insufficient and in order to assure the future safety of Cairo additional protection must be provided.

SAND BOILS AND SEEPAGE.

On account of the sandy nature of the sub-soil at Cairo there is a great deal of seepage during high water periods and sand boils within the levees become a serious menace.

A sand boil may be described as a spring, the water being under sufficient pressure and velocity to carry in suspension silt and sand from underlying strata. Such a boil when located near the inside toe of a levee may cause a settlement of the latter or it may develop an underground connection between the river and the inside area causing a "blow out." The greater danger lies in the settlement of the levee caused by the removal of large quantities of sand underneath, to such an extent that it may become weakened or over-topped by the flood.

Contrary to popular belief sand boils and seep water behind levees are not usually fed directly by rivers but from ground water put under pressure through lack of an outlet during highwater periods. Under certain conditions, however, it is believed that the flow may come directly from the river. For example where a sand strata outcrops on a river bank at a sufficiently low elevation, there will be a ground water flow toward the river during low water periods. During high water or flood periods a reversal of flow may occur resulting in seepage and sand boils from this same strata. Ordinarily this reversal of flow will be prevented through the filtering action of the sand, the voids on the outside being soon filled with silt removed from the water; however, in many cases the scouring action of the river current will prevent the formation of any layer of sediment of sufficient thickness to exclude leakage into the sand strata. It is believed that seepage of this kind occurred in several instances during the 1927 flood at Cairo. One case in mind is the boil at

the Cairo Ice-Cream and Milk Company plant described by Mr. Geo. F. Dewey, City Engineer, as follows:

"At two or three prominent sand boils the discharge was welled up with sack dirt to approximately a 48 foot elevation not checking the water flow but retaining the solids. One such large boil developed at the Cairo Ice Cream and Milk Company plant at Fourth and Commercial Avenue, around the casing of a new artesian well driven in August, 1926, to a depth of 190 feet. This boil was approximately 425 feet from the Ohio River and discharged several carloads of sand therefrom, and, after the recession of the river produced a subsidence in the Ohio river bank at a point from 75 to 125 feet south of Fourth Street, the location of the Government concrete river gauge."

PICTURE NO. 10.

Cairo Drainage District. Mississippi River Levee during High water of 1927. Inner Slope of Levee Sandbagged to Prevent Slides.

The subsidence above mentioned was clearly in evidence in January, 1929, and extended for a width of about 200 feet from the concrete wall down to and under the water surface, the gauge height at that time being about 18. Outcropping sand was noted a few feet above the water's edge. There is no direct evidence that water from the river entered through this sand, but it seems probable that it did. The greatest amount of subsidence, amounting to four or five feet, occurred only after about 600 cubic yards of rock had been dumped along the outside toe of the concrete wall to fill to original grade. This same sand boil also caused some settlement of the foundations of several buildings on the inside of the concrete wall at this locality.

The concrete wall at this point is about 16 feet high from bottom of foundation to top, with an outside toe of the foundation resting on interlocking steel sheet piling 16 feet long, driven into a sand strata of indefinite thickness. This wall retains on the inside a fill with railroad ballast and tracks to a height within four or five feet of the top. That there was no apparent settlement of this wall or the fill which it supports is remarkable.

Will the movement of large bodies of sand and water under the more solid soil and permanent structures, such as a concrete wall and buildings resting thereon, although stopped for the time being, create an unstable condition which may lead to a recurrence of the movement during future flood periods and eventually lead to disaster? Questions such

PICTURE NO. 11.

Cairo Drainage District. Ohio River Levee during High Water of 1927. Sand Boil Area "Welled Up" with Sand Bags.

as the above complicate the situation at Cairo and make the prevention of sand boils of vital importance.

The usual method of checking a sand boil is by means of a ring of sacks filled with sand or earth impounding the flowing water as in a well so as to create a counterhead which stops the inflow of the water. In some cases sub-levees are built to pond the water over wide areas behind the main levees. Both of these methods are expensive and of a temporary character and little adapted to a thickly populated locality. Standing water greatly detracts from the appearance of the city and creates unfavorable comment concerning the safety of the levees.

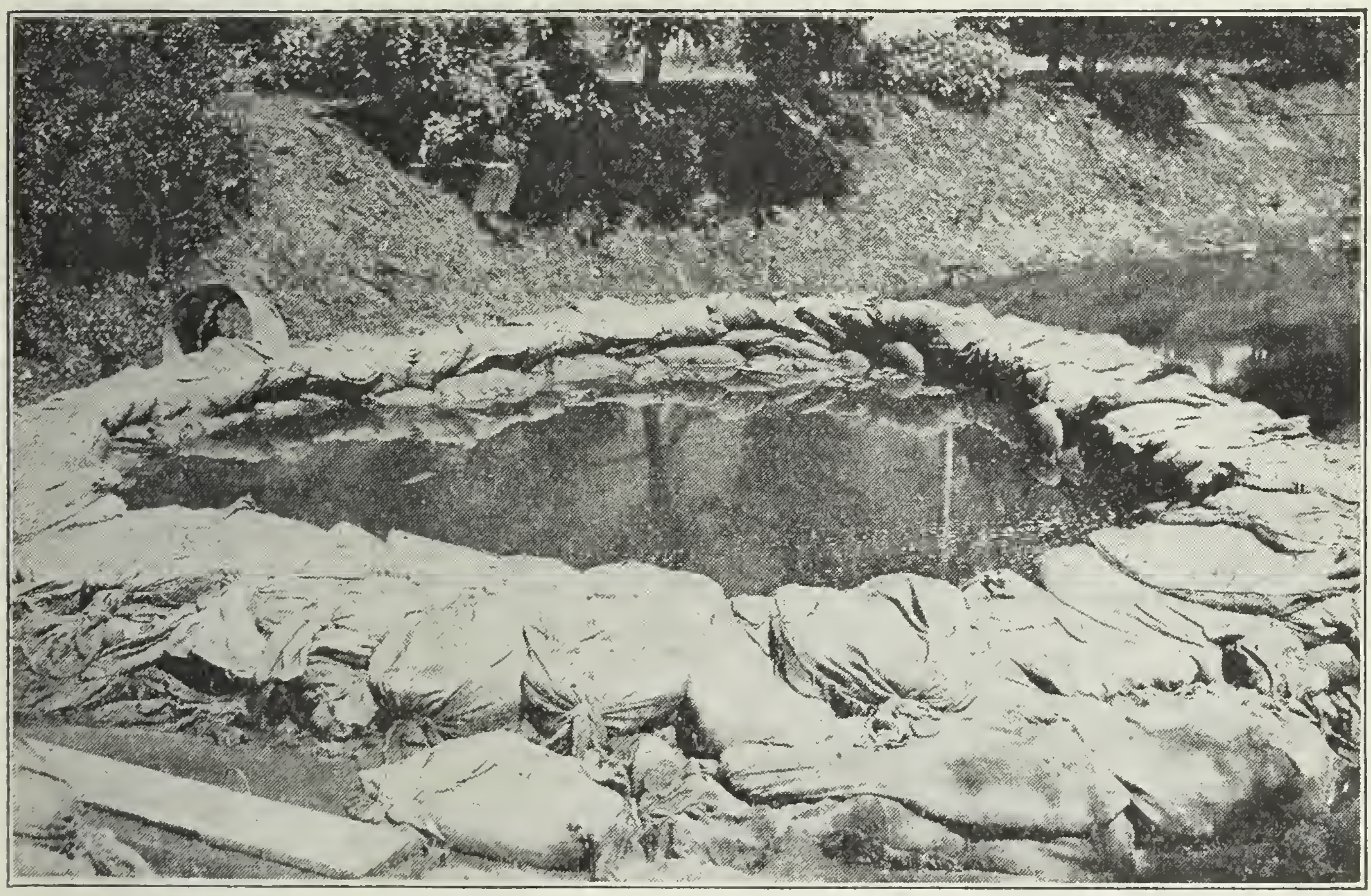
There is only one permanent satisfactory method and that is to fill in all low areas to an elevation high enough to prevent the recurrence of sand boils.

The sewer system of the City of Cairo, which is relied upon to remove seepage, drains by gravity at all river stages below 33 feet on the Cairo gauge. Above this stage pumps are operated as required, the maximum operating capacity at the higher stages being represented by one 18 inch and four 20 inch centrifugal pumps.

Mr. George Dewey, City Engineer, furnished the following figures concerning pumping operations during the period of March 16th to May 5th, 1927:

Rainfall (18.35″)	653,762,066 gallons	17 per cent
Artesian and driven wells	84,000,000 gallons	2 per cent
City Water Works	250,000,000 gallons	7 per cent
Traction Co.	250,000,000 gallons	7 per cent
Total visible supply	1,237,862,066 gallons	33 per cent
Total water pumped	3,768,480,000 gallons	100 per cent
Seepage	2,530,617,934 gallons	67 per cent

PICTURE NO. 12.



Cairo, Ill., High Water of 1927, a Typical Sand Boil.

The cost of pumping during the past 12 years has amounted to $109,000, or an average of about $9,000 per year.

SLIDES.

The occurance of slides is not the least of the dangers to be fought at Cairo in maintaining the levees against high water.

As a usual thing a slide on the inside slope of a levee is caused by the line of saturation which varies from a gradient of 5 to 1 to one of 7 or 8 to 1 extending outside of the inside slope. In such case the inside

toe of the levee has a tendency to slough off. This is prevented by the placing of sand bags, or other obstructions in the way.

Slides sometimes occur on the outside slopes of the Cairo levees due to the escape of ground water into the river on receding stages or by the movement of a layer of quicksand.

At Cairo the situation is aggravated by seep water being allowed to stand against the inside toe of the levee and by the fact that large quantities of cinder ballast or other porous material have been used from time to time in raising the railroad tracks on top of the levees. Porous material in the levee embankment itself has been the cause of many of the levee slides at Cairo.

The remedy for this situation is the building of banquetts on the inside slopes of levees or the use of flat inside slopes so as to bring the line of saturation inside the levee section. This construction will also tend to prevent sand boils. Slides on the outside slope can be permanently prevented only by constructing levees of proper material, with flatter outside slopes and located far enough away from the river bank.

In 1915 serious slides developed at three points on the outside of the Ohio River levee at Cairo just south of the Illinois Central Railroad bridge. The State Legislature appropriated funds to make the necessary repairs and the work was done by contract during the year 1916. The repairs consisted of wooden sheet piling driven near the bottom of the slope supported by round piling and stone filled cribbing, and a line of steel sheet piling near the crown of the levee anchored by means of tie-rods to heavy concrete blocks on the inside. Since these repairs were made some settlement has occurred and there has been some lateral top of the steel sheet piling. Some of this movement occurred after the movement of the sub-soil, and the filling resting thereon, forcing out the 1927 flood. During the summer of 1928 the Federal Government placed concrete revetment at this point, and it is believed that conditions are now stable and that there will be no more trouble. However, this is a danger point which should receive special attention in planning Cairo's flood protection.

CAVING BANKS.

Much trouble in times past has been caused by caving banks on both the Mississippi and the Ohio sides of Cairo and the Cairo Drainage District. A large amount of revetment, placed by the Federal Government has successfully prevented encroachment, but much more work needs to be done, especially along the Ohio River. It is believed that the U. S. Government engineers have the situation well in hand and that they will continue to give attention to it as future occasion demands. Nevertheless, there should be no interruption in the prosecution of a program which will provide adequate protection.

THE CAIRO DRAINAGE DISTRICT.

The interests of the Cairo Drainage District are so interwoven with those of the City of Cairo that they must be considered as one in matters of flood protection. Future City, a suburb of Cairo, lies in the drainage district, and all future expansion of Cairo must be northward in that direction. The principal industries, upon which the inhabitants of

Cairo rely for employment, and upon which the future prosperity of Cairo depends, are located in the drainage district. These industries include several large lumber companies doing an annual business of over $10,000,000.00. There are available many excellent factory sites, convenient to both rail and water transportation, which point to the early industrial development of the whole district. Flooding of the Cairo Drainage District would seriously interfere with railroad and highway communication into Cairo from the north. It is recommended, therefore, that the drainage district be included with Cairo in any plans for additional flood protection.

MOUNDS AND MOUND CITY.

Mound City has a population of about 3,200 and is located on the Ohio River about five miles north of Cairo. It is an industrial city having several large wood working plants, a large canning factory and a shipyard.

Protection against floods is furnished Mound City by a "ring" levee completely surrounding the town. This levee was first built in 1860, enlarged in 1885 and in 1899, and again in 1914. In the latter year and in 1915 the State of Illinois appropriated $60,000 toward the work which included a concrete wall along the water front. The total cost of this levee has amounted to over $150,000. The flood of April, 1927, was kept out of Mound City only by sand-bagging and building of timber bulkheads. Considerable damage was done to the levee at this time and repairs were made by the State in 1928 under the terms of the flood relief act.

The City of Mounds, about two miles west of Mound City, is the first station on the Illinois Central Railroad out of Cairo. This town was flooded in 1927 by the Mississippi River finding its way across the Cache River basin into the Ohio River.

The protection of both Mound City and Mounds should be a part of any comprehensive flood control plan dealing with Cairo.

THE ARMY FLOOD CONTROL PLAN AS AFFECTING CAIRO.

The Mississippi River flood control act, appropriating $325,000,000 for flood control construction along the Mississippi River, was passed during the first session of the 70th Congress (approved May 15, 1928). This act (printed in full at the end of this report) provides for the adoption of the flood control plan of the Chief of Engineers of the Army, subject to modification by the President as to any controversial features subsequent to recommendations by the Mississippi Flood Control Board. The Flood Control Board, in its report to the President, dated August 8th, 1928, recommends the plan of the Chief of Engineers practically unchanged, and it is assumed that the intention is to carry out this plan without substantial modification.

The provisions of the plan which are intended to relieve the flood situation at Cairo are:

(a) The levees protecting Cairo and the territory immediately north of Cairo as far as the Cache River are to be strengthened and raised to a height equivalent to 60 feet on the Cairo gauge (substantially their present height).

(b) A set-back floodway of five miles average width is provided from Bird's Point to New Madrid, on the other side of the Mississippi from Cairo, capable of carrying about 450,000 second-feet if entirely cleared, the existing river side levee to have fuse-plug sections at each end, the one on the north to be built to elevation 55 on the Cairo gauge.

This is the most vital part of the Federal Governments' flood control program, so far as it relates to the City of Cairo, and since Cairo, more than any other city in the State of Illinois, is affected by flood conditions of the Mississippi River, the people of the State of Illinois are particularly interested in seeing that the plans proposed are adequate and acceptable for Cairo's protection.

FLOOD CONTROL BOARD'S VIEW.

In explanation of the design of the Birds Point to New Madrid Floodway and of its effect on flood levels at Cairo as computed by the Chief of Engineers, paragraphs 20 and 21 of the Report of the Flood Control Board to the President are quoted herewith:

"20. From Birds Point to New Madrid, Mo., the floodway provided for by the adopted project will hold the maximum flood predicted as possible to 59 on the Cairo gauge and one foot below the proposed levee height. This will give a reasonable degree of safety to Cairo with its 15,000 inhabitants. In addition, this floodway, by reducing flood heights, will render the St. Francis Basin in southeast Missouri and Arkansas less liable to an accidental crevasse due to excessive flood heights. The riverside floodway plan offers the best solution for the situation at Cairo and vicinity because it gives a greater lowering of the flood plane than any other practical plan and provides greater safety to more property and lives. It is the one desired by the greatest number of those vitally interested. The Mississippi River Commission plan raises the levees opposite Cairo two feet, the same as the adopted plan. but makes no provision against a superflood.

"21. A public hearing was held at New Madrid, Mo., at which the proposed Birds Point-New Madrid superstage floodway was freely discussed. In addition, an extensive treatise on the subject was submitted to the board by interested parties. Some divergent conclusions on the hydraulics involved have been expressed. However, when these are analyzed closely it is found that the practical result of the floodway will be what is desired. The first experts to study stages at Cairo, Ill., predicted the maximum possible flood as one which, if confined, would produce a stage of 66; and this figure corresponded to a discharge of from 2,250,000 to 2,400,000 second-feet. The maximum stage was deduced on the assumption that each foot of gauge height above stages which have occurred would be produced by a certain amount of water computed from past measurements. Later other experts calculated that as the river rose and the slope became steeper, each foot on the gauge would represent a greater amount of water. This resulted in a stage, if confined, of about 63 for the same total discharge that was used in the first place as corresponding to 66 on the gauge. In both cases, if about 450,000 second-feet should be allowed to pass out of the river channel the resulting gauge height at Cairo would be about 59. All experts have found that the stretch of minimum capacity of the flood way would carry this amount or more. One expert expressed it by saying that the critical stretch, uncleared, would carry 150,000 second-feet and if cleared it would take about four times this amount (600,000 second-feet). The stretch in question is cleared and will undoubtedly remain cleared, so there need be no apprehension about its accommodating 450,000 second-feet, which amount taken out of the river in a superflood will hold the Cairo gauge to about 59. The plan of the adopted project proposes to permit water to spill into the floodway at stage 55 Cairo, so that great floods of lesser volume than the maximum flood will also be reduced in height. The 1927 flood actually produced a stage of 56.4 at Cairo without accident and an equal flood under the plan of the adopted project will produce a stage of about 55½ for a short time

only. It should be remembered that a flood approximating in volume the maximum predicted as possible can, according to predictions, occur, on the average, only once in 200 years."

PROTECTION OF CAIRO A VITAL MATTER.

Whether the Army plan, now being put in operation by the Federal Government, will or will not adequately protect the City of Cairo from danger of destruction by any possible flood, is a question of vital importance to the people and government of the State of Illinois.

Engineers do not all agree that the plans proposed are adequate or safe.

The Division of Waterways has considered this subject as being far too serious to be ignored or dismissed without full consideration. In harmony with this view, and to the end that opposing views might be presented, an arrangement was made with the Berthe Engineering Company to make an independent investigation and report on the entire flood situation in the vicinity of Cairo, with recommendations as to what other or further flood protective works, if any, are necessary, permanently and positively, to protect Cairo, Mounds and Mound City from inundation. Essential parts of said report are included herein.

SECTION II—REPORT OF THE BERTHE ENGINEERING CO.

THE PROBLEM AT CAIRO.

The real problem of river control begins at Cairo and the complexity of this problem is such that it not only requires thorough investigation and careful study in order that a safe and sound solution be finally adopted, but, due to the influence which the manner of solution will inevitably exert upon the commercial and economic future of the City of Cairo, and through that, upon the entire southern section of Illinois included within the trade territory of that city, such conditions may justify some participation by the State itself in certain items of cost if by such participation a plan of greater economic benefit to that section of Illinois will result.

FLOOD MENACE AT CAIRO.

The importance and seriousness of the flood menace at Cairo is admitted. As an indication of the seriousness of that flood menace we quote the following from the report of the Chief of Engineers:

"Cairo, Illinois, has a population of about 15,000. Its levee is at elevation 60 on the gauge. Parts of the city are 20 feet below this elevation. This city is situated on the point of land between the Mississippi and Ohio where escape from a flood which overflows the levees will be almost impossible. The 15,000 people should be protected against the highest water predicted as possible............. The actual top of the present levee is 60. It has been estimated that with the discharge confined within the limits of the present levee, stages are possible as high as six feet above the present levee top."

MEASURE OF PROTECTION NECESSARY.

As indicating the measure of protection which should be provided under such conditions, and that it should not be measured by the yard-

stick of cost but by the standard of safety; and as also demonstrating that there is a sure remedy, although not included or recommended in his plan, we quote this further extract from the report of the Chief of Engineers:

"The catastrophe resulting from a crevasse on a city front would be so appalling that *no measure should be spared to prevent it. A sure remedy* would be the filling in of the land to bring it above the limit of dangerous overflow."

DEMAND FOR FURTHER STUDY.

As an indication of the complexity of this problem we quote from an editorial in the February 23, 1928, issue of the Engineering News-Record as follows:

"Probably nowhere else up and down the Mississippi River does the engineer face a harder flood control problem than at Cairo, Illinois. .... By its very nature the Cairo problem involves all of the complex financial, physical and political aspects of Mississippi River Flood Control as a whole."

LOCATION AND ECONOMIC IMPORTANCE.

Cairo is located at the extreme southern tip of the State of Illinois on a narrow strip of alluvial land built up by the river flood plane between the Mississippi and Ohio Rivers at their junction. It is at the head of year around navigation on the Mississippi River, an important barge line terminal and a "breaking" point for freight rates in every direction, making it a natural and logical location for various manufacturing, assembling and distributing industries. It has a present population of approximately 15,000 of which about two-thirds are white. The city is served by the Illinois Central, Missouri Pacific, Mobile & Ohio and Big Four railroads as well as by river connections with the Federal barge line and other river carriers. A highway bridge now under construction will form a connecting link between the State highway systems of Illinois and Missouri at this location.

CITY OF CAIRO VALUATIONS.

The assessed valuation of the City of Cairo proper for taxation purposes is $11,376,209.00, exclusive of railroad and utility property. The total assessment for Alexander County, including the City of Cairo and industrial district is $19,612,616. The actual values have been estimated at from $36,000,000 to $50,000,000.

PROTECTIVE WORKS AND TOPOGRAPHY.

The city is surrounded by a levee system about seven miles in length and contains an area of 1,300 acres within the levee system. The ground elevations in the city vary from 310 to 323 feet above zero of the Memphis datum plane or from 33 to 46 feet above the zero of the Cairo gauge. The zero of the Cairo gauge being equivalent to 277.04 Memphis datum. Memphis datum will be used in this report as being more convenient since all levee grades in Missouri, Tennessee and Kentucky are referred to that datum. The average ground elevations in Cairo are about 320 Memphis datum or 43 feet on the Cairo gauge.

The elevation of the lands on the Missouri bank opposite Cairo vary from 322 to 326 feet, being from twelve to sixteen feet higher than the lowest land in Cairo and from two to six feet higher than the average elevation of Cairo.

The grade or top of the Cairo levees is equivalent to 60 feet on the Cairo gauge, the top of the concrete wall at the gauge being at elevation 337 Memphis datum. The section of the levee line along the Ohio River front of the city consists of a concrete wall backed up with earth fill, the top of the wall extending from two to eight feet above the top of the earth fill and the foot of the wall being protected against under-seepage with a line of interlocking steel sheet piling. The remainder of the levee line is of earth, the major portion serving a joint use as a railway embankment. All of the controlling city levees are up to the equivalent of 60 feet on the Cairo gauge and although there is considerable variation in section, all have wide crowns and no sections have been noted with less than three to one side slopes. While the use as an embankment for railway trackage appears to possess a material advantage in a more thorough solidification, as well as facilitating maintenance and emergency work, there is an attendant disadvantage in that the penetration of ballast carrying with it a certain percentage of voids into the center of the embankment causes this to act as a reservoir for rain water which tends to bring about slides in the embankment in finding its way out. This has probably been the incipient cause of the slides which have developed at certain locations along the earthen levees.

HEIGHT OF CAIRO LEVEES AND COMPARATIVE DIFFERENTIALS.

The heights of the city levees vary from 15 to 24 feet and compared with other levees in the alluvial valley are not only not excessive but somewhat below the average. The height of the levees protecting the City of New Orleans vary from 8 to 20 feet and some points in the city are 26½ feet below the levee grade. Levee heights of from 35 to 40 feet are not unusual in the lower valley. Improved street levels in Cairo are generally from 15 to 17 feet below the present levee grades but some of the lower unimproved areas in the city are as much as 27 feet below the levee grade although such areas are limited.

SAND BOILS.

While the underlying sub-strata of the city is of sand and gravel, there is a superimposed top strata of silt and clay which varies in thickness from only a foot or two in places to depths as great as ten or twelve feet. By reason of the porous sub-strata beneath the top soil, above-bank river stages bring about a rise in ground water pressure against the top soil. This accounts for the prevalence of sand boils during extreme high water stages at points where the top soil is thin or where it has been penetrated by wells, foundations or other excavations. It is conceded that sand boils constitute a serious menace to the maintenance of levees and bring about an increased hazard in times of high water. They should be eliminated in all instances and especially so in city areas.

While sub-levees and water blankets may be and are used to nullify their effects in agricultural areas, such methods are not adaptable to city conditions and they should be eliminated by a reduction in the differential between flood plane and ground levels.

C. E. SMITH REPORT.

A report by C. E. Smith, Consulting Engineer, retained by the City of Cairo in 1922 for a study and report on its flood problems, shows extensive investigations into sub-soil conditions at Cairo, locations where sand boils have been prevalent and advisable remedies. The report contains much other valuable information, and extracts from it will be found in the text.

DRAINAGE AND INDUSTRIAL DISTRICT.

Just north of the City of Cairo is the Cairo Drainage District comprising some 6,000 acres of land. Most of this is farming land although possibly about 600 or 700 acres is used as an industrial district at what is known as Future City and the Goose Pond Area along the Ohio River front. This district is bounded by the Mississippi River on the west, Cache River on the north, the Ohio River on the east and the City of Cairo on the south. The population of the drainage district was estimated in 1922 as about 2,500 but is now considerably less, probably not in excess of 2,000. The district is entirely surrounded by levees, the length of the surrounding levee line being between 14 and 15 miles and, except for the south levee which is part of the City of Cairo levee system, this levee line previous to 1927 flood was constructed to a grade equivalent to from 57 to 58 feet on the Cairo gauge. Except for the levee along the south bank of Cache River these levees also serve as railroad embankments. The protection of the area with this district presents no great difficulties. Being encircled by the levee system mechanical drainage becomes necessary during flood stages in the rivers.

LENGTH AND GRADES OF CAIRO LEVEE SYSTEMS.

The following tabulation of the levee system of the City of Cairo and the Cairo Drainage District appears in the C. E. Smith report herein before referred to and as there have been no changes other than maintenance since the date of that report, remains correct today.

The length and crown elevations of levees surrounding Cairo and the Drainage District, exclusive of cross levee, are as follows:

CITY OF CAIRO.

Location.	Length.		Crown elevation—Cairo gage.
	Feet.	Miles.	
Ohio side—			
Concrete	8,520	1.61	60.0′
Earth	4,550	.86	60.0′
Mississippi side—			
Earth	18,800	3.56	60.0′
Total	31,870	6.03	

CAIRO DRAINAGE DISTRICT.

Location.	Length.		Crown elevation—Cairo gage.
	Feet.	Miles.	
Ohio levee—			
Earth	14,916	2.82	58.0′
Mississippi levee—			
Earth	33,270	6.30	57.0 to 58.0′
Cache levee—			
Earth	28,253	5.33	
Total	76,439	14.45	

With the exception of the Cache River levee, at north end of Drainage District, all other levees are almost wholly occupied with railroad tracks. This occupancy occasions crown widths in excess of usual levee practice but the customary standard slopes of 3 to 1 appears to be well maintained over the entire system.

The Cache River levee has been strengthened by the State of Illinois with a 30-foot banquette added to the landside section.

RIVER STAGES AND FLOOD VOLUMES AT CAIRO—1882 TO 1927 INCLUSIVE.

In 1927 the river rose to a stage of 56.4 on the Cairo gauge, being the highest stage ever recorded at Cairo and it was estimated by the Weather Bureau that except for the relief resulting from the Dorena crevasse, 35 miles below Cairo, the river would have reached a stage of 57.7 or 58 feet. The local forecaster estimated 58 to 58½.

The following is a table of river stages and discharges at Cairo, Illinois as measured and shown by publications of the Mississippi River Commission.

Year.	Cairo crest gage readings.	Discharge, second feet.	Discharge measured at—
1882	51.87	*1,562,000	Helena.†
1883	52.17	(**)	
1884	51.79	1,520,000	Fulton.‡
1886	51.02	(**)	
1903	50.57	*1,686,000	Helena.
1907	50.33	1,543,000	Columbus.¶
1912	53.94	2,015,000	Columbus.¶
1913	54.69	2,015,000	Columbus.¶
1916	53.21	1,775,000	Columbus.¶
1920	51.40	1,527,000	Columbus.¶
1922	53.60	1,501,000	Columbus.¶
1927	56.40	¶1,800,000	Hickman.

* Discharge read at Helena includes contributions from the St. John, Obion and St. Francis watersheds and are therefore in excess of actual discharge at Cairo.

† Gage, 46.5.

** No discharge measurements.

‡ Gage, 35.

¶ Actual measurement at Columbus was 1,728,000 second feet, but was made when gage was 53.7 or 2.7′ below crest. Discharge computed by Mississippi River Commission to have been 1,800,000 second feet.

In 1916 and 1922 there was no crevasse which affected the Cairo gauge. In 1912 and 1913 there were crevasses both above and below Cairo, and in 1927 the Dorena crevasse, 30 miles below Cairo, took from

1½ to 2 feet off the crest. The effect of such crevasse was augmented by the diversion which obtained at and above New Madrid into the St. Francis basin and return water from which did not re-enter the main river until it reached the mouth of the St. Francis River near Helena.

SIZE OF FLOOD TO PROTECT AGAINST.

How large or great a flood should we protect against? It is generally conceded that 100 per cent protection is economically unfeasible. How far should we go and where should we stop? As a starting point, what has occurred can occur again and thus certainly protection should be provided against the greatest flood of record. From the character of development which has taken place in the alluvial valley during the past two decades, even with the partial protection afforded, we can form some concept of that which will follow the provision of greater protection. Fortunately in the 1927 flood, compared with the area flooded, the known loss of life was small. This was due to the fact that there were no crevasses upon city fronts. Yet over 600,000 people were driven from their homes. In another 20 years a similar flood affecting the same areas would probably make homeless a number twice as large.

We have been following a policy of designing flood control works to protect against the greatest flood of record. But records were broken in 1912 and 1913, along certain reaches in 1922 and finally again in 1927, four records over a span of 16 years, an average of a record every four years. Presumably following that policy we would eventually reach the greatest flood and protection against all floods of the future, but when a single flood can cause a known loss of over 200 lives, direct property damages of a quarter of a billion dollars and drive 600,000 people from their homes the hazard has become too great and the fallacy of the continuation of such a policy has become apparent. The time has come to give some attention to probabilities.

MAXIMUM PROBABLE FLOOD AS DETERMINED BY MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission working upon the basis of coincidental rainfall and flood volumes has arrived at the conclusion that the maximum probable flood along the lower Mississippi is represented by a flood volume of 25 per cent greater than that of 1927 at Cairo and 10 per cent greater below the mouth of the Arkansas.

MAXIMUM POSSIBLE FLOOD AS DETERMINED BY WEATHER BUREAU.

Working from another basis, that of relative stages as is used by the weather bureau in computing flood stages for daily forecast, the weather bureau arrived at a stage of 65 feet at Cairo as the maximum stage possible which Doctor Frankenfeld, Senior Meteorologist of the Bureau, stated probably would not happen once in 10,000 years but that it was within the realm of possibility. The publications of the bureau give this maximum possible stage at Cairo as from 65.5 to 66 feet. It also gives the 1927 confined stage at Cairo at from 57.7 to 58 feet. With a flood equal to that of 1913 in the Upper Ohio coincident with the 1927

flood in the Upper Mississippi the confined stage at Cairo is estimated at from 62 to 62½ feet. The probability of such a flood is not stated, but in consideration of the fact that there is no record of any such flood ever having occurred, and the further estimate of the Weather Bureau that 200 years would probably elapse before the recurrence of another flood along the reach below Vicksburg as great as that of 1927, it would seem reasonable to consider that such a flood as would result at Cairo from a coincidence of the 1927 Mississippi flood and the 1913 Ohio flood would take at least as long a probable time interval, that is, of not oftener than once in 200 years.

RELATIVE IMPORTANCE OF PROTECTION.

It is respectfully submitted that the importance of protection to agricultural districts as compared with that of protection to congested centers of population, as in large cities where the human life hazard enters to so much larger an extent into the equation, to such an extent in fact that General Jadwin stated that "the catastrophe resulting from a crevasse on a city front would be so appalling that no measure should be spared to prevent it," is not equivalent to the latter instance and that there appears to be no reason which would make equal protection economically justifiable.

It must first be remembered that these greatest floods, which are listed as barely within the realm of possibility, may never occur, and in the judgment of our best meteorologists would occur *only once in ten thousand years, if at all.*

It seems reasonable that in view of the human life hazard we might and should protect our congested centers of population against even this remotely possible flood, but should we attempt upon any ground to justify an expenditure at this time to protect the agricultural lands in the valley against an improbable but remotely possible flood the cycle of probable recurrence of which would be but once in ten thousand years?

EMERGENCY PROTECTION REQUIRED AT CAIRO.

Immediate Flood Hazards.—While it is conceded that floods may occur in the future which would overtop the Cairo levees it must be remembered that such a flood never has occurred. It will also be noted that with the present grade of the levees in Missouri, which are from one to two feet lower than at Cairo, it would require a greater than the probable flood to overtop the Cairo levees as the entire line of Missouri levees would first be overtopped.

The one principal danger with which Cairo is confronted is the lack of stability of her sub-soil and the prevalence of sand boils with the possibility that stages which approximated, but did not overtop her levees, might bring about pressures which would cause failures or blow outs in the levee foundations. There is also the question if the present levee sections are in all cases such as would successfully withstand long sustained flood periods with the flood plane within a foot of their top without complete saturation and danger from sloughing.

REDUCTION OF DIFFERENTIALS BY FILLING METHOD 100 PER CENT EFFECTIVE IN EVERY FLOOD.

The danger from boils is more imminent than the danger of overtopping the present levees. A flood much less than the maximum might produce a disaster through uncontrollable seepage. Proposed methods of reducing differentials by diversion are only partially effective or wholly ineffective against lesser floods than the maximum. The stages which caused the troubles in 1922 described in the Smith report are even below those at which diversion would start under the proposed plan. Raising the lowest portions of the city would largely eliminate this danger and reduce such hazard to a minimum and such method of reducing differentials would be fully effective in every flood. It would seem axiomatic that this should be the first step taken to secure a flood safe city.

Therefore the immediate emergency work, which is work that will be required regardless of any plan that may be adopted, should consist first of the filling up of the lower city areas to the elevations indicated in the following extract from the C. E. Smith report. According to that report this will require a total of 3,150,000 cubic yards within the city itself and 1,250,750 cubic yards in the industrial part of the Drainage District listed in that report as the Goose Pond Area, being a total of 4,400,750 cubic yards.

HAZARDS EMPHASIZED IN C. E. SMITH REPORT.

We quote the following from the C. E. Smith report as to the seriousness of the sand boil situation at Cairo and in the industrial district. It will be noted that these observations were the result of an investigation based primarily upon conditions which obtained during the 1922 flood which only reached 53.6 on the Cairo gauge, 5.4 feet below the maximum flood level provided in the Jadwin plan assuming the flood plane reduction works included in that plan to be 100 per cent effective. In other words, the Jadwin plan would permit an increase in differentials between flood plane and city levels at Cairo of 5.4 feet over the actual differentials which obtained in 1922 and 2.6 over those which obtained at the maximum 1927 flood crest, without providing any remedy for this evil other than the strengthening of levee sections.

FROM C. E. SMITH REPORT.

These sand boils and seep water studies should prove enlightening to the people of Cairo and awaken them to the necessity for promptly dealing with both problems. There is not much consolation in knowing that they originate in ground water instead of in the rivers and no one should let our explanation of the phenomena minimize, in their minds, the danger that is created by their annual appearance.

More levees, perhaps, have failed in the Mississippi Valley through undermining by sand boils and a softening of the base by seep water than from any other cause. Seep water rises slowly but sand boils break out suddenly and no one, charged with the maintenance of the

levees during high water, knowns when or where or what the result of the next one will be. They are treacherous and when combined with seep water there is presented one of the greatest evils to safety in flood protection.

About the only successful way to prevent sand boils and seep water is to increase the surface over the affected areas so that greater resistance will be offered to the rise of ground water, and increase the amount of pumping so as to lower the ground water level. That means that the low areas in the city must be filled and raised to a height to which ground water will not carry with a reasonable amount of pumping.

The following itemized statement taken from the C. E. Smith report includes those items which should be considered as necessary under any plan and which comprise the 4,400,750 cubic yards of filling recommended in a foregoing paragraph. The work while emergent, forms a necessary, in fact, the most necessary part of the permanent protective works for Cairo. Its ommission from flood control plan leaves the City of Cairo without any assured and certain protection from ultimate catastrophe. It will be noted from the depth of the fill that it will reduce extreme differentials far in excess of the reduction in maximum flood heights claimed for the Jadwin plan, and at least the major portion of it is an absolute essential whether or not the Missouri floodway is constructed.

Recommendations of C. E. Smith Report Concurred In.

FILLING OF LOW AREAS

We recommend the raising of all low areas within the city to an elevation level with established street grades, except at some points where that height will not provide a sufficient covering over sand boil areas or will not give enough stability to the inside levee slopes, where the filling should be carried higher behind the levees.

SUMMARY FOR CITY.

	Total
Original City	201,100 cubic yards
First Addition	764,950 cubic yards
Third Addition	51,850 cubic yards
Fourth Addition	60,800 cubic yards
Fifth Addition	267,200 cubic yards
Fairground Addition	3,850 cubic yards
Feuchter and Lansden 1st Addition	34,400 cubic yards
Feuchter and Lansden 2nd Addition	19,050 cubic yards
Edgewood Park Addition	10,450 cubic yards
Hooker's Addition	9,300 cubic yards
Burgois Addition	27,300 cubic yards
Miller's Addition	76,350 cubic yards
Farrell's Addition	12,700 cubic yards
Miscellaneous Property, west side	1,049,050 cubic yards
City Property—Streets, etc	382,700 cubic yards
Miscellaneous Property, north side	178,950 cubic yards
Total yardage	3,150,000 cubic yards

In the Goose Pond area in the drainage district, seep water reached elevation 30.2 City datum this year. The filling of that area to seep water height is almost compulsory and the yardage noted below is calculated on that basis:

CAIRO DRAINAGE DISTRICT.

Filling in Goose Pond Area calculated to 1922 seep water height, elevation 30.2 City Datum.

Owner.	Cubic Yards Required
C. C. C. and St. L. R. R. between north city limits and Logan property...	352,000
Future City Blocks and Streets....	432,000
C. C. C. and St. L. R. R. leased to Chicago Mill and Lumber Company....	12,760
J. T. Logan property, Goose Pond....	453,600
Total yardage	1,250,750

TOTAL YARDAGE TO BE HANDLED.

In City of Cairo....	3,150,000 cubic yards
In Drainage District, Goose Pond....	1,250,750 cubic yards
Grand total	4,400,750 cubic yards

Some modifications might advisedly be made in some of these items as listed in the Smith report, but a careful inspection with this report in hand indicated that the coverage was well worked out not only to provide a sufficient coverage to eliminate the sand boil evil, but to materially improve seep water conditions.

The Smith report considers the hydraulic fill method, which is unquestionably the correct and economic method, but the cost figures are based upon a single plant and a five-year program. The hazards are such that the work should not extend over so long a period, but should either be contracted for or provided with plant installation on a basis of completing this entire work in two years. In view of this fact the estimate of cost should be raised to 25 cents per cubic yard, making a total cost for filling of about $1,100,000.

Second: All earthen levee sections should be enlarged to the standard section now recommended by the Chief of Engineers. All of this presumes that caving or sliding banks along both Ohio and Mississippi River fronts will be protected by revetment or other bank stabilization works.

ARMY PLAN FAILS TO PROTECT AGAINST GREATEST HAZARD AT CAIRO.

It will be noted that this work, classified as emergency work and immediately necessary, as was evidenced by the extremely serious sand boil situation which obtained during the 1927 flood, and without which there can be no feeling of security in the City of Cairo during major river floods, forms no part of and is not included in the Army or Jadwin plan for flood control. Notwithstanding that these conditions approximated the safety limit in 1927 when the stage was only 56.4, and that in recognition of that fact and when there was no impending danger of the overtopping of the levee, the removal of all women and children from the city was seriously contemplated, the army plan, even if 100% effective, would submit this city to the additional hazard of stages as high as 59 feet without the provision of any remedy against this menace, which is more feared by the citizens of Cairo than any other.

Both the location of the sand boils and the geological formation clearly indicate that heavier levee sections alone will not eradicate this evil. Cairo stands in as much probable danger from this cause as it

does from overtopping of its levee system. No flood of record has occurred which would have overtopped her levees, but the sand boil evil has repeatedly reached proportions which taxed her resources to combat with stages which lacked from 3.6 to 6 feet of reaching the levee top. Only a program which would reduce the maximum flood plane below 55 feet on the gauge could be considered as making Cairo reasonably safe without raising of the lower city areas, and even then some filling over areas of thin top cover would be advisable.

REDUCTION OF FLOOD LEVELS.

It will be conceded that if economically practicable the ideal solution of the flood protective problem at Cairo would be by a reduction in flood levels sufficient to require no raise in levee grades.

EFFECT OF WINDSTORMS ON FREE-BOARD REQUIRED ON EARTHEN LEVEES.

It is the concensus of opinion of every engineer with active personal experience in combatting floods during windstorms on the lower Mississippi River that less than a three-foot free-board in an earthen levee constitutes an invitation to disaster. In 1920 with a 30-mile gale, a stage of only 51 feet, an effective free-board of seven feet with a thickness of levee of 44 feet at the water surface, it took a force of 200 men to withstand a wave attack along a front of only 1400 feet, and when the wind subsided, only from 12 to 15 feet of the 44-foot thickness at the water surface remained. In 1913, with a wind velocity much less, and only a two-foot free-board, several hundred men concentrated on a quarter of a mile of levee line were unable to avert a breach in the Missouri levee at Medleys. In 1927, a 20 to 28 mile gale, lasting 18 hours, cut levees with free-board of from four to seven feet several feet beyond the center line, notwithstanding a constant force of from 250 to 300 men to the mile of levee under attack. In 1920 the waves snapped 4x6 uprights like kindling wood. Only the man who has combatted wave action on earthen levees during a sustained 30-mile gale has any conception of the severity of that attack.

Considering the section proposed in the army report, a 3-foot free-board applied to the maximum section would give a thickness at water surface of 42 feet. Considering that this territory is subjected to terrific windstorms almost annually, that they have occurred during the high water season, that a considerable portion of the Cairo levee system is of earth and will so remain, and considering the special hazards involved, it would appear that the minimum free-board which can be applied to standard earthen levees in this locality, and provide a reasonable factor of safety at points where hazard to life exists, is three feet.

MINIMUM REDUCTION IN FLOOD PLANE REQUIRED TO MAKE PRESENT CAIRO LEVEE GRADES ADEQUATE.

The predicted maximum possible flood is 66 feet (Revised Army figures, 65 feet). The required reduction in flood plane to provide a three-foot free-board at Cairo would be nine feet. The proposed reduction of six feet in the Army plan would, if accomplished, leave not an

inch of free-board (Revised Army figure is one foot) against the maximum flood, and is therefore untenable—it would be a miracle if disaster were averted and certainly no such hazard should be applied to city areas. It is therefore respectfully submitted that the minimum reduction in flood plane which would of itself make present levee grades at Cairo adequate is nine feet.

PERMANENT PROTECTION.

It has been generally considered that several alternative methods may be applied in the protection of the City of Cairo, three of which are most frequently mentioned and will be considered herein.

A. A reduction in maximum flood plane to the extent that the present protective works will suffice.

B. An increase in levee grades and sections sufficient to give the city a safe free-board above the maximum flood.

C. A joint program of raising and strengthening the levee sufficiently to provide a safe free-board above the maximum flood plus sufficient filling in and rehabilitation of the lower city areas as will preserve a safe equilibrium between flood plane and city grade and eliminate the sand boil evil.

CAN LEVEE GRADES BE RAISED AT CAIRO?

We must differ with any conclusion that either a 30, 40, or even 50-foot levee is unsafe regardless of section. To agree with such conclusion would be to condemn every existing earthen dam of over 30, 40 or 50 feet in height as an unsafe structure. We do not believe that it is the element of safety which now operates to limit levee heights along the Mississippi River, but the element of economy instead. That levee heights are, along some reaches of the river, approaching their economic limit, may be conceded, and it is quite evident that the Tensas basin floodway is included in the plan not so much as a safety requirement as of a measure of economy.

The proposed five-mile floodway in Missouri alone will not protect Cairo without a raise in levee grades. As already cited herein, no reduction of less than nine feet in maximum flood plane can provide Cairo with a safe free-board of three feet on her earthen levees if their grade is held at 60 feet. But such a reduction in flood plane is clearly without the limits of economic feasibility.

NOT PROHIBITIVE IN COST.

While the readjustment of railway tracks, building rehabilitation and the raising of the concrete wall for the concrete wall section along the Ohio River front presents some problems of a different nature from ordinary earthen levee construction through agricultural districts, they are not of a difficult nature, nor, for such a moderate raise in grade as may be found necessary, prohibitive in cost. The estimate of the Government engineers of $3,070,000 for a six-foot raise in grade of the entire city system is indicative of this fact.

THREE-FOOT RAISE IN LEVEE GRADE PRACTICABLE.

Nobody will seriously question the practicability of a three-foot raise in the Cairo levee system with suitable levee sections and the filling in of the low areas in the city and industrial district to the extent recommended herein, which, while it would reduce the extreme differentials between city levels and levee grades from six to seventeen feet, would not involve any rehabilitation costs of consequence, as was clearly shown in the Smith report.

ECONOMICAL AND ADVANTAGEOUS TO CAIRO.

Such a program would give the City of Cairo an assured free-board above even the possible flood and a greater factory of safety against any flood plane than the Army plan alone. It further possessed the flexibility required in that, if the free-board on the earthen levee sections appear inadequate, a two-foot raise in these sections can be made at a comparatively nominal cost and the concrete wall, where less free-board is required, left at a lower grade. When the entire cost of a six-foot raise in the City's levee system was estimated at $3,070,000 (Engineering News-Record, February 23, 1928), it is evident that this plan will not be prohibitive in cost.

AUTHORITY OF GOVERNMENTAL AGENCIES TO REDUCE DIFFERENTIAL BY FILLING.

The question may arise as to the power or authority of the executive agencies in charge to include in the plan such an item as the filling in of the low areas in the City of Cairo and its industrial district to the extent recommended and required to establish what will be beyond a doubt a safe equilibrium between city levels and maximum flood plane. The purpose of the act is stated to be for the control of floods, but the word "protection" occurring in the act indicates clearly that the purpose of such flood control is to provide protection. The act does not restrict the executive agencies to any particular method of securing the desired results and certainly no court would construe that they do not hold authority to use both the most effective and most economic method of accomplishing such results. We believe that any such objection would be swept aside by the courts as a mere quibble and contrary to the intent and purpose of the act itself.

It is suggested that in the improbable event that the law should be so construed to prevent the federal agencies from doing this work, the State of Illinois could just as consistently participate in the cost of same as it could in the expense of repairing the levees after the 1927 flood.

WILL REDUCE PUMPING COSTS AT CAIRO.

It is deemed to be beyond the financial ability of the City of Cairo to participate in such costs; it will require such resources as they can command to provide rights of way for the enlarged levee sections. No detailed estimate of cost of this right of way is as yet available, but it will not be materially increased by a three-foot raise in grade. In ad-

dition to the provisions of rights of way it will devolve upon the city to maintain and operate its pumping equipment, which is an indispensable necessity to any city or area surrounded by a ring levee. While the work proposed will tend to materially reduce the amount of seep water pumpage, it will not by any means eliminate that necessity, nor can it be eliminated unless and until the entire city is filled to a grade above the flood plane.

ADDITIONAL DRAINAGE REQUIREMENTS.

While considerable improvement has been made in the arrangement of the city's drainage pumps and one unit added since 1922, the present installation, consisting of one 18-inch and four 20-inch centrifugal pumps, all electrically driven, either direct of through belts, seep water levels averaged a foot higher in 1927 than in 1922. Although additional pumping capacity will undoubtedly ultimately be required, the immediate requirement is a revision of the sewer system to the end that the maximum performance can be had from the existing installation. The existing leads from some of the outlying heavy seepage areas are too small to relieve the area, and capacity of pumping units exceeds the rate of delivery to them to such an extent that only intermittent operation is possible. A general revamping and reconstruction of much of the mileage of the city's drainage sewers with features of construction which will tend to prevent sand infiltration, minimize water hammer, and permit continuous operation during pumping periods appears necessary before satisfactory drainage conditions can be maintained during prolonged high water stages.

We do not hold with the C. E. Smith report that lowering of ground and seep water levels by increased pumping will reduce flood hazards at Cairo. Such action is undoubtedly necessary to maintain satisfactory living and health conditions, but does not relate to the problem of river flood control, except to the extent that the elimination of present water cover during floods through increased pumping will, unless such areas are earth filled to such degree as to maintain at least the same equilibrium as that which obtained from the water blanket thus removed, actually increase such flood hazards.

The matter of drainage being therefore a municipal rather than a problem of river flood control, any detailed discussion of such problem is without the scope of this report. It is well to call attention to the fact, however, that unless there is a substantial filling of the low seep water areas, the city is precluded from affecting material improvement in flood-time seep water conditions through danger from an increased flood hazard resulting from a decrease in the counter-balancing effect of the seep water blanket.

OHIO WATER FRONT TREATMENT.

The raising of the existing concrete wall along the Ohio water front a matter of three feet presents no serious or unusually expensive construction difficulties. It is deemed essential that all basements along this frontage be abandoned and filled, and desirable from a commercial standpoint that landside fill should be raised at least an equivalent if

not a greater amount, preferably to the height of the present wall. Such filling would require a considerable amount of building rehabilitation along this frontage, the cost of which would be largely, if not wholly, compensated for by increased commercial advantages.

PROBLEMS AT MOUNDS AND MOUND CITY—1927 FLOOD AND PRESENT CONDITIONS.

In the 1927 flood the City of Mounds was flooded by Mississippi River water finding its way from the Mississippi River across the Cache River basin into the Ohio River, these flood waters not only flooding the City of Mounds, but also surrounding and encircling the town of Mound City. This latter town was not flooded, being protected by its ring levee.

Due to the work done since the 1927 flood, after flood gates are provided at drainage openings, such condition will not occur again for river stages against which the present levee grades are effective. The sub-grade of the Illinois Central main line tracks which protect the town of Mounds on the north and west, together with Illinois State Highway No. 2 and a short connecting link of levee between that highway and the Illinois Central embankment just south of Mounds constructed by the State of Illinois, will protect Mounds and Mound City on the south and west.

FLEXIBILITY OF PLAN.

While these improvements, including the circle levee around Mound City, will be effective in protecting these two towns only against confined floods which do not overtop them, which means floods of less than 58 feet at Cairo, all of the levees are of moderate height and can be increased in height and section to provide protection against any flood.

This leaves a considerable area between Mounds and Mound City and north and west of State Highway No. 2 subject to flooding by back water from the Ohio River, but State Highway No. 147, being constructed north from the eastern limits of Mound City, to the same grade as State Highway No. 2, will provide, after flood gates are provided at drainage openings, equivalent protection for this area within which is located the national cemetery. Thus some eight miles of levee structures, all of which, with the exception of the short connecting link at Mounds between State Highway No. 2 and the Illinois Central embankment, is occupied either by railroad tracks or a state road, will, with properly adjusted grades and sections, provide completely effective protection to the towns of Mounds and Mound City and the area between.

NON-INTERFERENCE WITH HIGHWAY SURFACING AND R. R. TRACKS.

Levee grades and sections can be increased to the extent found necessary by riverside enlargement without any interference either with the railroad tracks or highway surfaces. This by reason of the fact that the present grade is sufficiently high that it will constitute a perfectly safe banquette and the probable limited raise in levee grades which may be found necessary above it will not require any modification in banquette section.

CACHE FLOODWAY PRESERVED.

This plan now in effect leaves the Cache River open, thus leaving an open floodway between the levees protecting the areas north and east of the Cache River and the levees of the Cairo Drainage District, through which flood waters may flow unobstructed from the Mississippi into the Ohio or vice versa. This seems to be a very desirable feature since, within the limit of its effectiveness it will tend to equalize the conditions between the two rivers and especially to relieve a congested condition on the Mississippi side when subjected to unbalanced flood loads as in 1927. There appears to be a material advantage to the City of Cairo in retaining the Cache River flood-time cross connection as an equalizer between the two rivers, and it should not be closed, unless a further detailed study of the situation should determine its effects to be nominal. It appears that the solid embankment approaches of the Cache bridge on State Highway No. 2 have encroached upon this Cache floodway to the extent that they may be difficult of maintenance, although they will have no important effect upon flood levels.

PROTECTIVE WORKS WITHIN SCOPE OF MAIN RIVER IMPROVEMENTS.

With the exception of that portion of the levee system which will be included in that portion of State Highway No. 147, extending north from Mound City, and the Ohio River front levee of Mound City itself, all of this levee line on the north and west side of Cache River is necessary as a protection against headwater overflow from the Mississippi River and is properly a component part of the flood control improvements of the main river. The only portion of the protective works which can conceivably be classified as coming within the "tributary" clauses of the flood control act is that reach of levee extending along the Ohio River front at Mound City and north from Mound City along State Highway No. 147 to the hills.

PRESENT PROTECTIVE WORKS AT MOUND CITY.

Mound City is protected by a ring levee about 3½ miles in total length, with a grade approximately equivalent to a corresponding Ohio River stage of 60 feet on the Cairo gauge, with crown widths averaging 10 feet and side slopes varying from 2 to 1 to 3 to 1. While this levee has had some emergency repairs since the 1927 flood, that reach of the levee extending from State Highway No. 147 to the Ohio River bank and along the Ohio River front is very deficient in section and a substantial increase in section would appear to be imperative.

ENCROACHMENT OF MANUFACTURING PLANTS UPON LEVEE.

Unfortunately almost the entire river front, immediately behind the levee, is occupied by a number of manufacturing plants, mostly stave mills, veneering mills or other woodworking plants which are not only built immediately against the levee but encroach upon it. One of the sequences of such action is to be seen in the very steep landside slopes immediately opposite these plants resulting in unusually deficient levee cross sections. The prosperity of the city depends almost entirely upon the continued successful operation of these plants, as they constitute practically its only industries.

RIVERSIDE ENLARGEMENT POSSIBLE NORTH FROM RAILROAD AVENUE.

The present levee along this reach averages about 12 feet in height. A short section of the levee, between 400 and 500 feet in length, south of Railroad Avenue, is protected with a concrete wall which extends from two to three feet above the top of the earth embankment. There is also a concrete core wall flush with top of levee extending some 800 feet north from First Street.

Considering the reach north from Railroad Avenue there is ample room for riverside enlargement to adequate cross-section. This will involve, however, the removal of some loading sheds between Railroad Avenue and Second Street and of the power house and one of the woodworking shops of the veneering mill located in the block south of Fourth Street, which structures are all on the riverside of levee. All of these manufacturing establishments on landside of levee should be required to remodel to the extent of non-encroachment upon the levee structure itself.

LANDSIDE ENLARGEMENT NECESSARY SOUTH OF RAILROAD AVENUE.

Along the reach of this levee extending south or down river from Railroad Avenue to the point where the levee leaves the Ohio River bank and turns south, being a distance of some 2000 feet, no riverside enlargement is possible and a substantial landside enlargement is imperative.

Immediately adjoining and encroaching on this levee on the landside is a saw mill and woodworking plant which will have to be moved to permit of this landside enlargement. It is along this reach that a portion of the concrete wall extends and the river bank has scoured away to the extent that buttress footings of the concrete wall have been exposed, although the footings of the wall itself, from the best information obtainable without boring test, extend some eight feet below.

RIVER BANK SCOUR.

While there is evidence of very considerable river bank scour along this particular reach and some rip-rap has been placed in an attempt to stop it, it is not a caving bank and would appear to be susceptible of effective local remedial treatment by additional rip-rapping or by retards or short deflecting hurdle dikes above. Apparently the scour has been due to deflection of current into the bank at this point through the influence of certain dikes constructed on the Kentucky bank above. The correction of this condition apparently comes within the scope of channel improvements and will undoubtedly be taken care of by the governmental agency holding such jurisdiction. It is mentioned, however, because it will need attention in the near future, although it does not constitute any immediate menace to the stability of the levee. The city drainage and seep water is cared for during river flood stages by drainage pumps. We have not investigated the adequacy of the pumping equipment as not being within the province of this report.

PROBABLE COST.

Although some special structures such as concrete riverside toe walls and possibly some concrete retaining walls on the landside where manufacturing plants are located may be found advisable or necessary when a detailed plan for the improvement of this Ohio front levee is worked out, it is improbable that such details will involve any expenditures of magnitude. The two expensive features will be the acquirement of necessary rights of way for landside enlargement and the transporting of the material with which to make the enlargement, as no pits are available opposite the work and it will therefore be a haul-in job. Prevailing Ohio River stages do not indicate any available source of supply from which material could be economically placed in the levee section by the hydraulic method. If such were found practicable on the riverside enlargement reach, a concrete toe wall would be required along a considerable portion of the reach to limit the slope of the hydraulic dredged material within the area available. Roughly approximated, the enlargement and rehabilitation of this reach of levee, including the connecting reaches along Trinity Slough and on the north to State Highway 147, may cost from $150,000 to $160,000 if constructed to the maximum section recommended in the report of the Chief of Engineers, which should certainly be used on city fronts. Right of way costs may appear high, but some 175,000 cubic yards of material is involved, including special structures and unit costs will be high. Without a detailed knowledge as to just what occupancy by the various manufacturing plants is held by fee title it is impossible at this time to closely approximate right of way cost.

LEVEE MILEAGE IN THIS PROTECTION UNIT.

With the completion of the levee along State Highway No. 147 north from the eastern limits of Mound City to the hills, it does not appear that it will be necessary to maintain the back levee at Mound City or that part of same which lies to the north and west of said highway, although it could be maintained by the city as emergency protection if so desired. Eliminating this back levee will give a total levee length from Mounds to the hills north of Mound City, including the levee line along the I. C. Railroad embankment, State Highway No. 2, State Highway No. 147, the Mound City Ohio River front levee, and that reach of the Mound City ring levee extending from State Highway No. 147 along the north bank of Trinity Slough to connect with the Ohio River front levee, of approximately eight miles. Of this eight miles, four miles, extending from Mounds to the Ohio River front levee at Mound City is chargeable to protection from Mississippi River flood water and the remaining four miles to back water protection. Of this latter four miles, one and one-half miles is along the Mound City frontage and two and one-half miles along State Highway No. 147, extending north from Mound City to the hills. The whole forms a loop extending north from hills at Mounds south to the Cache bottoms, then along the north line of these bottomlands and the north bank of Trinity Slough to the Ohio River, thence along the river bank

past the town of Mound City and north to the foothills. The protected area, including the towns of Mounds and Mound City, is approximately six square miles and constitutes a self-contained flood control unit which cannot be flooded by the failure of any levees except its own.

ADVISABLE ADDITIONAL LEVEES.

The present protective works for Mounds and Mound City and intervening territory, even when completed, will leave an area of some 40 or 50 square miles lying south of Fayville and Olive Branch and west of Mounds unprotected, and this does not include what is known as the "Dog Tooth Bend" area to the south, which it is deemed economically unfeasible to protect.

The protection of this area to the west, while presenting no construction difficulties, would involve the closure of the Cache cut-off between the Mississippi and Ohio Rivers, with its equalizing effects on the two rivers. In 1913 the flood waters crossed from the Ohio to the Mississippi and in 1927 the process was reversed, the Mississippi water flowing across to the Ohio.

Nevertheless, this would seem to be the constructive thing to do. The Mounds-Mound City loop would have to be maintained as a protection against Ohio River backwater, but less increase in grade and section would be required to adequately serve that purpose. Under present conditions and without a levee to the west shutting off Mississippi River flood waters from these levees, their grade should be raised a matter of from two to three feet to provide a safe free-board against the maximum possible flood. Some less raise than that might be required towards the Mounds end of the loop if the west levee were constructed, but the difference would be nominal.

MISSISSIPPI RIVER LEVEES WEST OF CACHE RIVER.

Two alternative routes are available for the protection of that portion of Alexander County lying south of the C. and E. I. R. R. and north of the Cairo Drainage District.

One route would be to follow proposed State Highway No. 150, which parallels on the east side the Mounds-Olive Branch line of the I. C. R. R. from Cache to Olive Branch, utilizing the highway embankment as a levee from the point where it leaves the Cairo Drainage District to Olive Branch. This would involve some minor drainage diversions, but is generally a good levee location and except at the southern end would not require any high levee. Another exception would be at the crossing of Lake Creek and another slough just south of it where some high fill would be necessary over unstable soil. The total length of this levee line would be about seven and one-half miles and it would add about 25 square miles to the area protected against maximum floods.

The other route would be to construct a riverside enlargement of the embankment of the Cairo and Thebes branch of the Missouri Pacific R. R. Co. from Beech Ridge to Fayville, with a short connection at Beech Ridge over to the M. and O. levee of the Cairo Drainage District. This

would involve about 11½ miles of construction as compared with 7½ miles of the Highway 150 route, but it would protect approximately 20 square miles of additional territory, included in which is the Horse Shoe Lake State Park, and would also afford protection to a considerable additional mileage of improved highways as well as the Missouri Pacific tracks from Fayville to Beech Ridge. This levee would not necessarily follow the railroad throughout, but deviate to the west to follow the crest of the ridge to the north and west of Miller City. It has the further advantage of non-interference with the natural drainage to Horse Shoe Lake and in spite of the fact that it is about four miles longer is the preferable route of the two.

WITHIN JURISDICTION OF MISSISSIPPI RIVER FLOOD CONTROL PLAN.

This levee from the Cairo Drainage District Levee near Beech Ridge to Fayville would constitute a main river levee under the provisions of the flood control act and no local contributions would be required other than rights of way, which item the territory affected could easily take care of. The levee should be constructed and it is respectfully suggested that the State of Illinois request that it be included within the flood control plan.

CONCLUSIONS AND RECOMMENDATIONS.

1. That a 66-foot confined flood at Cairo as the maximum possible flood may be considered a safe assumption.

2. That an economically justifiable program would protect centers of population against the greatest possible flood and agricultural areas against the greatest probable flood.

3. That to provide a safe free-board for earthen levee sections against the maximum flood with no raise in levee grades at Cairo will require a reduction in elevation of maximum flood plane of nine feet.

4. That a reduction in extreme differentials between city levels and levee grade at Cairo is imperative and that a certain amount of filling in of the lower areas is necessary to establish a safe equilibrium.

5. That, whether or not the Missouri Bird's Point-New Madrid floodway is constructed the Cairo levees should be raised.

Additional flood protection measures recommended are therefore:

1. The filling in of low areas in the City of Cairo and its industrial district to the extent of 4,400,750 cubic yards for the purpose of reducing the extreme differentials of 27 feet between city elevation and levee grade to not to exceed 20 feet, as compared with the modified grade, substantially along the lines of this report.

2. That the low area in the City of Cairo and in the industrial part of the Cairo Drainage District be filled by the hydraulic method in substantial accordance with the recommendations of the C. E. Smith report, involving a total quantity of 4,400,750 cubic yards with little or no rehabilitation cost. (The filling recommended is itemized in this report.)

3. That the controlling levee grade for the Cairo grade point be fixed at a minimum of 63 feet on the Cairo gauge. It is deemed ad-

visable that the grade of the earthen levee sections protecting the City of Cairo be raised two feet above this controlling grade.

4. It is understood that the present orders of the War Department required the lowering of the central 3000 feet of the solid embankment approach at the Illinois end of the Cairo-Missouri bridge a matter of ten or eleven feet. It is respectfully suggested that in lieu of such action, and as a part of the flood control plan, suitable equalizer openings be provided in this embankment and its present grade preserved.

SECTION III.

COMMENTS AND CONCLUSIONS BY DIVISION OF WATERWAYS

The Division of Waterways agrees in the main with the conclusions and recommendations contained in the report of the Berthe Engineering Company, as submitted herewith, except that a raise in grade of two feet only for earth levees is recommended as of immediate importance instead of the higher grade proposed in the Berthe report, proper consideration to be given in the future to a further raise in grade after observations have been made as to the effect of the operation of the Bird's Point-New Madrid floodway on Cairo gauge heights. The views of the Division of Waterways in the matter are indicated by the following comments and conclusions.

"THE GREATEST POSSIBLE FLOOD"

After all is said and done, flood records do not go back far enough to give sufficient data on which to base a prediction of the magnitude of the greatest possible flood. The U. S. Weather Bureau has said that a maximum flood at Cairo will occur when maximum floods in the Ohio and the Upper Mississippi meet at that point. This is considered a remote possibility, but the maximum floods considered in the Upper Mississippi and the Ohio, although greater than has ever obtained before in either river, are based on records covering a comparatively limited period of time.

The Army Plan states that a maximum flood will be one of 2,250,000 to 2,400,000 second-feet, producing a stage at Cairo, if confined, to 63, which stage, it is claimed, will be reduced by the proposed Bird's Point-New Madrid floodway to 59.

To compute the exact discharge in cubic feet per second and the resulting gauge height of the confined flood at Cairo we believe to be very difficult, in view of the uncertain factors involved. In computing such a discharge, errors or differences of 10 to 15 per cent are obtained by different experts, but these differences matter little in view of the greater uncertainty involved in determining what a maximum discharge is.

From time to time expert engineers have established grade lines and sections for the Mississippi River levees which they believed to be sufficient, only to have to revise their estimates and increase their fac-

tors of safety in the light of data furnished by new and more disastrous floods.

The lesson to be drawn from this appears to be that a factor of safety should be introduced to cover the uncertainties, by designing flood protection works stronger than is thought necessary, in order to protect from the expected maximum. Certainly where human life is at stake additional expenditure for this purpose is fully warranted.

FREQUENCY OF THE GREATEST POSSIBLE FLOOD.

When we speak of the greatest possible flood we will, of course, have in mind how soon such a flood may occur. We believe that all estimates as to the frequency of the greatest possible flood to be mere guesswork. There is nothing in the records to show that the maximum possible flood will not come within 200 years or even 100 years. We do not know whether two such floods will occur 50 years apart, and then not another one for 400 years, or whether to expect our first one 50 or 200 years hence. A present generation may know such a flood or perhaps no one now living will be alive when such a flood occurs. The fact that such a flood never has occurred in the period covered by our records does not prove it impossible.

It is not believed possible, however, to go beyond a period of 100 years in designing levees and floodways for flood protection. When overflowed frequently, floodways have a habit of filling up gradually by sedimentation,. thus reducing their capacity. What may be sufficient now in the way of design may not be sufficient for the same purpose later. As time passes, however, changes in the condition of floodways may be noted and guarded against, additional knowledge will be gained concerning the behavior of great floods and necessary additional construction provided.

CITY VS. COUNTRY AREAS—FLOOD PROTECTION.

In sparsely settled areas there is a limit beyond which it may not be economical to go in providing flood protection. In fact, in many cases it is found uneconomical to protect farming lands from floods occurring once in 30 to 50 years. Conditions are changing, however. We are in a day of progress. Paved roads are being built through drainage and levee districts, and better transit facilities are provided in all directions. The flooding of a protected area now not only causes a local loss, but affects the whole surrounding country. Then, too, people are demanding the right of safe living free from even the thought of a possibility of danger. The human life hazard is being given first consideration in all areas.

With densely populated city areas there can be no question of the necessity of complete protection from all possible floods. Here we have danger to human life. A great flood is on the way—no one knows how great. The flood approaches the danger line. A near-panic develops and perhaps the inhabitants must be removed to places of safety at great cost in suffering and money. Even though levees may not break, great damage has been done because of lack of confidence. Confidence

—a sense of safety—to be justified, must be engendered by knowledge of *safe levee construction.* No government could justify its failure to remove the inhabitants of a city whose levee was being washed by waves in a 30-mile gale with the water within a foot of the top.

PROTECTION FROM THE GREATEST POSSIBLE FLOOD A NECESSITY OF THE PRESENT.

There is a tendency to think of a disaster which may happen but infrequently, as too remote to be guarded against. We must not lose sight of the fact that no man can tell when such a disaster will take place. In the fall of 1926 a record flood occurred on the Illinois River in this State. In the spring of 1927, in spite of many predictions to the contrary, a flood of equal magnitude occurred. Protection from the greatest possible flood is of vital importance to the people of Cairo *today.*

THE BIRD'S POINT-NEW MADRID FLOODWAY.

Conceding, as we do, that every assumption and every calculation made by the engineers in the design of the Bird's Point-New Madrid floodway has been honestly made, nevertheless it is believed that this floodway, as designed, is more or less of an experiment and that no one, today, has sufficient knowledge of the actual working characteristics of such a floodway to enable him to determine with any degree of certainty the effect of its construction on gauge heights at Cairo. More research and experiment are needed with the Mississippi River, itself, before such a determination can be made. It is expected that, with the Army Flood Control Plan in operation, there will be opportunity to observe, under actual operating conditions, the performance of this and other floodways and that within a few years only, knowledge will be gained which will enable such revisions as may seem advisable to be made in existing plans.

FREEBOARD NECESSARY IN EARTH LEVEE CONSTRUCTION.

The Army Flood Control Plan provides for the maintenance of the existing levee grade of 60 on the gauge at Cairo and by means of the Bird's Point-New Madrid floodway for reducing the maximum possible flood stage to 59, thus providing a freeboard of only one foot.

It will be readily understood that should a flood ever reach 59 it would take an enormous amount of labor and be very costly to furnish the necessary additional protection required for Cairo's 20 miles of levees by means of sandbags and bulkheads. In fact, should a windstorm develop, it would be an impossible task.

The lives of the people of Cairo should not be jeopardized in this manner. That earth levees must have a freeboard, and that the absolute minimum recognized by engineers is three feet, is a well-known fact. In the case of a city where many lives are at stake there can be no question of the necessity of a freeboard, and three feet might reasonably be regarded as not enough.

NECESSITY OF PROTECTING AREAS NORTH OF THE CAIRO DRAINAGE DISTRICT.

In the Berthe report the suggestion is made that an area of 40 or 50 square miles, lying south of Fayville and Olive Branch and west of Mounds, be closed by a levee connecting with the Cache River Levee of the Cairo Drainage District. At the present time a cut-off exists between the Mississippi and Ohio Rivers at this point, the flood waters flowing in either direction as determined by the relative elevation of the two streams. It is not known just what the equalizing effect of this cut-off is, but it is thought that any disadvantage arising from its closing by the proposed levee may be balanced by a saving in the cost of levees to protect Mounds and vicinity.

It is believed that the protection of this area is desirable as a part of the general flood protection plan, because, in addition to protecting a large adjacent agricultural area, it would relieve to some extent the State highways and railroads, included in the area, from damage incident to an extremely high flood in the Mississippi.

The Division of Waterways has not investigated the feasibility of this prospect and it is not known what difficulties in the way of providing for stream diversion and interior drainage may exist. In the absence of additional information the project appears desirable.

FILLING OF LOW AREAS OF CAIRO AND CAIRO DRAINAGE DISTRICT.

It is a well established fact that the greatest menace to the City of Cairo is the danger of breaks in the levees caused by seepage and sand boils rather than breaks caused by weakness of section or overtopping. Several times, during flood periods, sand boils have developoped which, before they could be placed under control, have washed large quantities of sand from underneath levees causing dangerous settlement. In some of these cases disaster has been averted by a narrow margin.

Sand boils begin to be dangerous when floods reach an elevation of 50 on the gauge, a point nine feet below the predicted possible flood height. It has been stated that the sand boil menace at Cairo will be reduced when the Army Plan is in operation, floods of lesser volume than the maximum spilling over into the Bird's Point-New Madrid floodway through the proposed fuse-plug section, at elevation 55 Cairo gauge, causing a reduction of flood height. It is believed that as far as relief from sand boils is concerned, the effect of the floodway will be nominal and that there will still remain the possibility that a flood much less than the greatest possible flood will produce a disaster.

It is recommended as necessary that the low areas of the City of Cairo and the adjoining Drainage District be filled substantially as recommended in the C. E. Smith report and that of the Berthe Engineering Company. It is believed that the work can be done economically by hydraulic dredge. This measure is of far more immediate importance than the raising of the levees.

RAISING AND STRENGTHENING LEVEES.

The statement has been made that Cairo has reached the limit in levee height and that future flood relief must come through a lowering of the flood crest. It would be very desirable to protect Cairo in this manner and the Bird's Point-New Madrid floodway is designed to do this but falls short of furnishing the dependable degree of security necessary for a city population.

The common objections to higher levees in Cairo are three:

1. Associated with the higher levee idea is that of a higher flood level and the possibility of increased trouble and danger from sand boils and seepage.
2. The fear of injury to the city commercially, because high levees are thought to create a bad impression and lack of confidence as to Cairo's safety as a business or residence location.
3. Higher levees are thought to be less secure.

The first two objections will be overcome to a large extent by the filling in of the low areas of the city and drainage district as contemplated. The sand boil menace will be removed or at least greatly reduced and the levees will not appear as high with the low areas filled in.

The second objection in any case does not seem to be a reasonable one, as higher and stronger levees should convey the impression of greater rather than less security.

The third objection cannot be held valid as with a raise of two or three feet Cairo's levees will still be lower than many of the levees along the lower Mississippi River.

It is believed that the earth levees protecting Cairo, the Cairo Drainage District, Mounds and Mound City should be built to an elevation corresponding to 62 on the Cairo gauge and that security against the maximum possible flood of the Army Plan can be obtained only in this way.

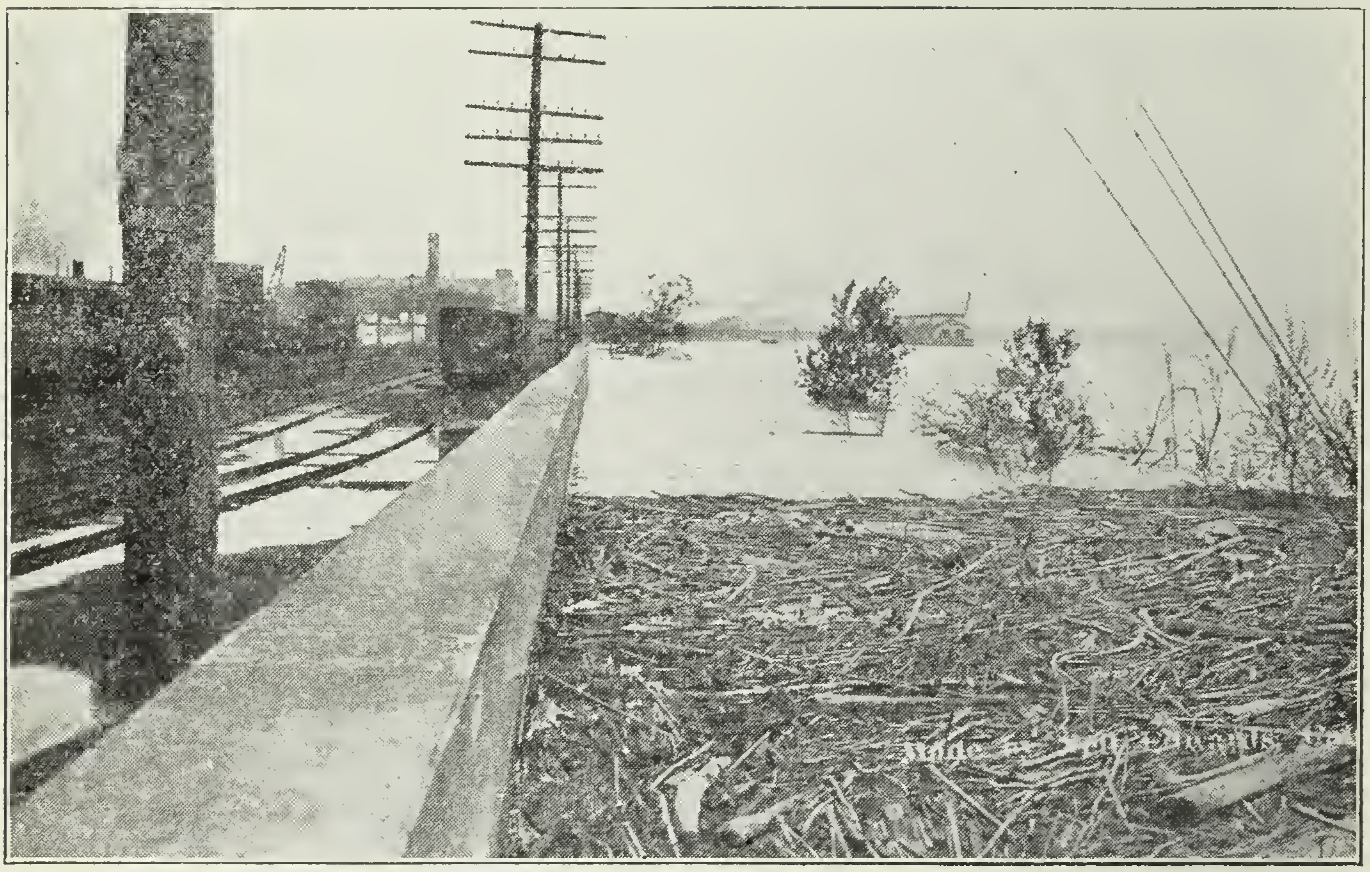
This raise in levee elevation is believed necessary to secure a dependable freeboard above the 59-foot stage admitted as possible. In recommending a two-foot raise no consideration is given to the need of an additional factor of safety to cover uncertainties in determination of the possible maximum flood height, either those involved in the prediction of the maximum possible flood or those included in the design of the Bird's Point-New Madrid floodway, but it is recommended that the question of the necessity of additional security be given proper future attention. It is believed to be very probable that an opportunity will be given for engineers to judge the efficiency of the present plan by observing its operation during minor floods. It is recommended that measures be taken to secure these data during future flood periods.

In addition to raising the grade of the earth levees at Cairo, it is recommended that the section be increased to conform to the standards adopted by the Chief Engineer for similar soil conditions. Economy should not be the ruling factor in design. Cairo's levees instead of being just safe enough should have a factor of safety. Good material for levee construction can be obtained within reasonable distance of

Cairo but with higher stages floods will remain for longer periods against the levees and there will be greater danger of saturation and sloughing of the inside slopes. It is believed that a proper factor of safety requires a section which will retain a line of saturation of 6 to 1. A stronger section should be adopted if later soil tests demand it. The stronger section with flatter inside slopes or banquettes will also tend to lessen the danger from sand boils near the inside toe.

There are no unsurmountable obstacles in the way of raising and strengthening the levees at Cairo. The Mississippi River levee of Cairo and the Cairo Drainage District, except for a short distance, can be raised by a river-side enlargement. The Cache River levee of the Cairo Drainage District can be raised by either a river-side or an inside enlargement. The Ohio River levee of the Cairo Drainage District for a

PICTURE NO. 13.



Cairo, Ill. Seawall, built by the State of Illinois in 1915, protecting the City from inundation by the flood of 1927. Picture was taken near the crest of the flood.

portion of its length must be raised by an inside enlargement. Just south of the Illinois Central Railroad bridge, where slides have occurred, it may be necessary to move levee and tracks further away from the river, or adopt a special type of construction.

On account of the sandy nature of the sub-soil, borrow-pits adjacent to levees are not advisable and it will be necessary to secure material elsewhere and haul it in by dump cars, utilizing the existing railroad tracks or making use of an industrial track system.

On account of the advisability of protecting railroads and highways which enter Cairo from Mounds and Mound City, additional protection for these cities should be provided by river-side enlargements of existing structures, viz., the Illinois Central Railroad on the west, State Highway No. 2 on the south and State Highway No. 147 on the east. If it

is not found practicable to raise these embankments to an equivalent of 62 Cairo gauge, this amount of protection at least should be provided for the two cities by constructing a new ring levee for Mounds and by raising and strengthening the levee at Mound City.

THE CONCRETE SEA WALL.

The concrete wall built by the State of Illinois in 1915 is believed to be strong enough to withstand the expected flood stage of 59. A plan for providing additional freeboard to protect from wave action, either by the addition of flash boards or by the raising of the wall itself, should be adopted as a part of Cairo's ultimate plan for flood protection. It is not believed that it will be found practicable or necessary to raise the railroad tracks on the inside of the sea wall as advocated in the report of the Berthe Engineering Company. Certain areas on the outside of the concrete wall should be filled and new revetment provided.

FLOOD PROTECTION PROVIDED BY THE FLOOD CONTROL ACT OF 1928.

The Mississippi River Flood Control Act of 1928 provides that the Federal Government shall furnish flood protection to the City of Cairo by paying the entire cost of strengthening the existing levees and raising them where necessary to the grade equivalent of 60, Cairo gauge. Local agencies must furnish the necessary right-of-way, remove obstructions, construct railroad and road crossings and bear all expense except that of the actual levee construction. At the present time (1929) the Federal Government is proceeding with this work. The raising and enlarging of the Mississippi River levee of the City of Cairo and the Cairo Drainage District is nearly completed and plans are being made to raise and strengthen the Ohio River levee.

The cost of this work to the Federal Government, when completed, will be in the neighborhood of $1,600,000.00. Additional cost to be borne by local interests will be about $125,000.00. When the above work is completed, in order to completely enclose Cairo and the Cairo Drainage District with a levee to the adopted grade, the levee along Cache River must be strengthened and enlarged. At the present time it is not known to what extent the Federal Government will participate in the cost of rebuilding this levee. During certain flood periods the Mississippi River flows through the Cache basin to the Ohio; therefore, it seems that this levee should be considered as a main Mississippi River levee and paid for entirely by the Federal Government.

It is understood that additional levee protection is being planned for Mounds and Mound City. It is not known at the present time to what extent the Federal Government will participate in the cost of this work.

ESTIMATE OF COST OF RECOMMENDED ADDITIONAL FLOOD PROTECTION.

On account of the uncertainty which exists as to the amount of work which will be paid for by the Federal Government and on account of the absence of accurate surveys showing topography, the grade, section and alignment of levees, railroad embankments and other existing structures, it is not possible to estimate with any degree of accuracy the cost of the additional flood protection recommended. It is believed that the filling of the low areas of Cairo and the Cairo Drainage District as recom-

mended by the report of the Berthe Engineering Company can be done for not to exceed $1,200,000.00. Before an accurate estimate can be made, however, of this work and of the additional cost of raising the levees of Cairo, Mounds and Mound City to the recommended grade of 62 Cairo gauge, an accurate survey should be made. This survey should include the accurate topographic mapping of the city and low areas of the Cairo Drainage District. The estimated cost of such a survey, together with the engineering studies and plans for additional flood protection for Cairo, Mounds and Mound City, is $20,000.00.

CONCLUSIONS, RECOMMENDED ADDITIONAL FLOOD PROTECTION FOR CAIRO, MOUND CITY AND MOUNDS.

In order to provide the degree of protection necessary for a city area it is the opinion of the Division of Waterways that the Army Plan as known at present should be supplemented by the following relief measures.

1. The low areas of Cairo and certain parts of the Cairo Drainage District should be filled in substantially as recommended by the report of the Berthe Engineering Company.

2. The earth levees only of the City of Cairo, the Cairo drainage District, Mounds and Mound City should be raised to a grade elevation corresponding to 62 feet on the Cairo gauge so as to provide a three foot free-board above the maximum possible flood anticipated by the Army Flood Control Plan.

3. All earthen levee sections should be enlarged to conform to the latest standard sections adopted by the Chief of Engineers for similar soil and sub-soil conditions.

4. It is suggested that the feasibility of constructing a levee on the east bank of the Mississippi River northward from the Cache River levee of the Cairo Drainage District be investigated and, if found feasible, that the Federal Government be requested to construct this levee as a part of the flood control plan.

5. A complete survey should be made of Cairo and adjacent areas in advance of the preparation of any final plans and estimates.

SECTION IV—THE MISSISSIPPI RIVER FLOOD CONTROL ACT.

(Public—No. 391—70th Congress.) (S. 3740.)

An Act For the control of floods on the Mississippi River and its tributaries, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the project for the flood control of the Mississippi River in its alluvial valley and for its improvement from the Head of Passes to Cape Girardeau, Mo., in accordance with the engineering plan set forth and recommended in the report submitted by the Chief of Engineers to the Secretary of War dated December 1, 1927, and printed in House Document Numbered 90, Seventieth Congress, first session, is hereby adopted and authorized

to be prosecuted under the direction of the Secretary of War and the supervision of the Chief of Engineers: *Provided,* That a board to consist of the Chief of Engineers, the president of the Mississippi River Commission, and a civil engineer chosen from civil life to be appointed by the President, by and with the advice and consent of the Senate, whose compensation shall be fixed by the President and be paid out of the appropriations made to carry on this project, is hereby created; and such board is authorized and directed to consider the engineering differences between the adopted project and the plans recommended by the Mississippi River Commission in its special report dated November 28, 1927, and after such study and such further surveys as may be necessary, to recommend to the President such action as it may deem necessary to be taken in respect to such engineering differences and the decision of the President upon all recommendations or questions submitted to him by such board shall be followed in carrying out the project herein adopted. The board shall not have any power or authority in respect to such project except as hereinbefore provided. Such project and the changes therein, if any, shall be executed in accordance with the provisions of section 8 of this Act. Such surveys shall be made between Baton Rouge, Louisiana, and Cape Girardeau, Missouri, as the board may deem necessary to enable it to ascertain and determine the best method of securing flood relief in addition to levees, before any flood-control works other than levees and revetments are undertaken on that portion of the river: *Provided,* That all diversion works and outlets constructed under the provisions of this Act shall be built in a manner and of a character which will fully and amply protect the adjacent lands: *Provided further,* That pending completion of any floodway, spillway, or diversion channel, the areas within the same shall be given the same degree of protection as is afforded by levees on the west side of the river contiguous to the levee at the head of said floodway, but nothing herein shall prevent, postpone, delay, or in anywise interfere with the execution of that part of the project on the east side of the river, including raising, strengthening, and enlarging the levees on the east side of the river. The sum of $325,000,000 is hereby authorized to be appropriated for this purpose.

All unexpended balances of appropriations heretofore made for prosecuting work of flood control on the Mississippi River in accordance with the provisions of the Flood Control Acts approved March 1, 1917, and March 4, 1923, are hereby made available for expenditure under the provisions of this Act, except section 13.

Sec. 2. That it is hereby declared to be the sense of Congress that the principle of local contribution toward the cost of flood-control work, which has been incorporated in all previous national legislation on the subject, is sound, as recognizing the special interest of the local population in its own protection, and as a means of preventing inordinate requests for unjustified items of work having no material national interest. As a full compliance with this principle in view of the great expenditure estimated at approximately $292,000,000, here-

tofore made by the local interests in the alluvial valley of the Mississippi River for protection against the floods of that river; in view of the extent of national concern in the control of these floods in the interests of national prosperity, the flow of interstate commerce, and the movement of the United States mails; and, in view of the gigantic scale of the project, involving flood waters of a volume and flowing from a drainage area largely outside the States most affected, and far exceeding those of any other river in the United States, no local contribution to the project herein adopted is required.

Sec. 3. Except when authorized by the Secretary of War upon the recommendation of the Chief of Engineers, no money appropriated under authority of this Act shall be expended on the construction of any item of the project until the States or levee districts have given assurances satisfactory to the Secretary of War that they will (a) maintain all flood control works after their completion, except controlling and regulating spillway structures, including special relief levees; maintenance includes normally such matters as cutting grass, removal of weeds, local drainage and minor repairs of main river levees; (b) agree to accept land turned over to them under the provisions of section 4; (c) provide without cost to the United States, all rights of way for levee foundations and levees on the main stem of the Mississippi River between Cape Girardeau, Missouri and the Head of Passes.

No liability of any kind shall attach to or rest upon the United States for any damage from or by floods or flood waters at any place: *Provided, however,* That if in carrying out the purposes of this Act it shall be found that upon any stretch of the banks of the Mississippi River it is impracticable to construct levees, either because such construction is not economically justified or because such construction would unreasonably restrict the flood channel, and lands in such stretch of the river are subjected to overflow and damage which are not now overflowed or damaged by reason of the construction of levees on the opposite banks of the river it shall be the duty of the Secretary of War and the Chief of Engineers to institute proceedings on behalf of the United States Government to acquire either the absolute ownership of the lands so subjected to overflow and damage or floodage rights over such lands.

Sec. 4. The United States shall provide flowage rights for additional destructive flood waters that will pass by reason of diversions from the main channel of the Mississippi River: *Provided,* That in all cases where the execution of the flood-control plan herein adopted results in benefits to property such benefits shall be taken into consideration by way of reducing the amount of compensation to be paid.

The Secretary of War may cause proceedings to be instituted for the acquirement by condemnation of any lands, easements, or rights of way which, in the opinion of the Secretary of War and the Chief of Engineers, are needed in carrying out this project, the said proceedings to be instituted in the United States District Court for the district in which the land, easement, or right of way is located. In all such proceedings the court, for the purpose of ascertaining the value of the

property and assessing the compensation to be paid, shall appoint three commissioners, whose award, when confirmed by the court, shall be final. When the owners of any land, easement, or right of way shall fix a price for the same which, in the opinion of the Secretary of War is reasonable, he may purchase the same at such price; and the Secretary of War is also authorized to accept donations of lands, easements, and rights of way required for this project. The provisions of section 5 and 6 of the River and Harbor Act of July 18, 1918, are hereby made applicable to the acquisition of lands, easements, or rights of way needed for works of flood control: *Provided,* That any land acquired under the provisions of this section shall be turned over without cost to the ownership of States or local interests.

Sec. 5. Subject to the approval of the heads of the several executive departments concerned, the Secretary of War, on the recommendation of the Chief of Engineers, may engage the services and assistance of the Coast and Geodetic Survey, the Geological Survey, or other mapping agencies of the Government, in the preparation of maps required in furtherance of this project, and funds to pay for such services may be allotted from appropriations made under authority of this Act.

Sec. 6. Funds appropriated under authority of section 1 of this Act may be expended for the prosecution of such works for the control of the floods of the Mississippi River as have heretofore been authorized and are not included in the present project, including levee work on the Mississippi River between Rock Island, Illinois, and Cape Girardeau, Missouri, and on the outlets and tributaries of the Mississippi River between Rock Island and Head of Passes in so far as such outlets or tributaries are affected by the backwaters of the Mississippi: *Provided,* That for such work on the Mississippi River between Rock Island, Illinois, and Cape Girardeau, Missouri, and on such tributaries, the States or levee districts shall provide rights of way without cost to the United States, contribute 33 1/3 per centum of the costs of the works, and maintain them after completion; *And, provided further,* That no more than $10,000,000 of the sums authorized in section 1 of this Act, shall be expended under the provisions of this section.

In an emergency, funds appropriated under authority of section 1 of this Act may be expended for the maintenance of any levee when it is demonstrated to the satisfaction of the Secretary of War that the levee can not be adequately maintained by the State or levee district.

Sec. 7. That the sum of $5,000,000 is authorized to be appropriated as an emergency fund to be allotted by the Secretary of War on the recommendation of the Chief of Engineers, in rescue work or in the repair or maintenance of any flood-control work on any tributaries of the Mississippi River threatened or destroyed by flood including the flood of 1927.

Sec. 8. The project herein authorized shall be prosecuted by the Mississippi River Commission under the direction of the Secretary of War and supervision of the Chief of Engineers and subject to the provisions of this Act. It shall perform such functions and through such agencies as they shall designate after consultation and discussion with

the president of the commission. For all other purposes the existing laws governing the constitution and activities of the commission shall remain unchanged. The commission shall make inspection trips of such frequency and duration as will enable it to acquire first hand information as to conditions and problems germane to the matter of flood control within the area of its jurisdiction; and on such trips of inspection ample opportunity for hearings and suggestions shall be afforded persons affected by or interested in such problems. The president of the commission shall be the executive officer thereof and shall have the qualifications now prescribed by law for the Assistant Chief of Engineers, shall have the title brigadier general, Corps of Engineers, and shall have the rank, pay, and allowances of a brigadier general while actually assigned to such duty: *Provided,* That the present incumbent of the office may be appointed a brigadier general of the Army, retired, and shall be eligible for the position of president of the commission if recalled to active service by the President under the provisions of existing law.

The salary of the president of the Mississippi River Commission shall hereafter be $10,000 per annum, and the salary of the other members of the commission shall hereafter be $7,500 per annum. The official salary of any officer of the United States Army or other branch of the Government appointed or employed under this Act shall be deducted from the amount of salary or compensation provided by, or which shall be fixed under, the terms of this Act.

Sec. 9. The provisions of sections 13, 14, 16 and 17 of the River and Harbor Act of March 3, 1899, are hereby made applicable to all lands, waters, easements, and other property and rights acquired or constructed under the provisions of this Act.

Sec. 10. That it is the sense of Congress that the surveys of the Mississippi River and its tributaries, authorized pursuant to the Act of January 21, 1927, and House Document Numbered 308, Sixty-ninth Congress, first session be prosecuted as speedily as practicable, and the Secretary of War, through the Corps of Engineers, United States Army, is directed to prepare and submit to Congress at the earliest practicable date projects for flood control on all tributary streams of the Mississippi River system subject to destructive floods which projects shall include: The Red River and tributaries, the Yazoo River and tributaries, the White River and tributaries, the Saint Francis River and tributaries, the Arkansas River and tributaries, the Ohio River and tributaries, the Missouri River and tributaries, and the Illinois River and tributaries; and the reports thereon, in addition to the surveys provided by said House Document 308, Sixty-ninth Congress, first session, shall include the effect on the subject of further flood control of the lower Mississippi River to be attained through the control of the flood waters in the drainage basins of the tributaries by the establishment of a reservoir system; the benefits that will accrue to navigation and agriculture from the prevention of erosion and siltage entering the stream; a determination of the capacity of the soils of the district to receive and hold waters from such reservoirs; the

prospective income from the disposal of reservoired waters; the extent to which reservoired waters may be made available for public and private uses; and inquiry as to the return flow of waters placed in the soils from reservoirs, and as to their stabilizing effect on stream flow as a means of preventing erosion, siltage and improving navigation: *Provided,* That before transmitting such reports to Congress the same shall be presented to the Mississippi River Commission, and its conclusions and recommendation thereon shall be transmitted to Congress by the Secretary of War with his report.

The sum of $5,000,000 is hereby authorized to be used out of the appropriation herein authorized in section 1 of this Act, in addition to amounts authorized in the River and Harbor Act of January 21, 1927, to be expended under the direction of the Secretary of War and the supervision of the Chief of Engineers for the preparation of the flood-control projects authorized to be submitted to Congress under this section: *Provided further,* That the flood surveys herein provided for shall be made simultaneously with the flood-control work on the Mississippi River provided for in this Act: *And provided further,* That the President shall proceed to ascertain through the Secretary of Agriculture and such other agencies as he may deem proper, the extent to and manner in which the floods in the Mississippi Valley may be controlled by proper forestry practice.

Sec. 11. That the Secretary of War shall cause the Mississippi River Commission to make an examination and survey of the Mississippi River below Cape Girardeau, Missouri, (a) at places where levees have heretofore been constructed on one side of the river and the lands on the opposite side have been thereby subjected to greater overflow, and where, without unreasonably restricting the flood channel, levees can be constructed to reduce the extent of this overflow, and where the construction of such levees is economically justified, and report thereon to the Congress as soon as practicable with such recommendations as the commission may deem advisable; (b) with a view to determining the estimated effects, if any, upon lands lying between the river and adjacent hills by reason of overflow of such lands caused by the construction of levees at other points along the Mississippi River, and determining the equities of the owners of such lands and the value of the same, and the commission shall report thereon to the Congress as soon as practicable with such recommendation as it may deem advisable: *Provided,* That inasmuch as the Mississippi River Commission made a report on the 26th day of October, 1912, recommending a levee to be built from Tiptonville, Tennessee, to the Obion River in Tennessee, the said Mississippi River Commission is authorized to make a resurvey of said proposed levee and a relocation of the same if necessary, and if such levee is found feasible, and is approved by the board created in section 1 of this Act, and by the President the same shall be built out of appropriations hereafter to be made.

Sec. 12. All laws or parts of laws inconsistent with the above are hereby repealed.

Sec. 13. That the project for the control of floods in the Sacramento River, California, adopted by section 2 of the Act approved March 1, 1917, entitled "An Act to provide for the control of the floods of the Mississippi River and of the Sacramento River, California and for other purposes, "is hereby modified in accordance with the report of the California Débris Commission submitted in Senate Document Numbered 23, Sixty-ninth Congress, first session: *Provided,* That the total amounts contributed by the Federal Government, including the amounts heretofore contributed by it, shall in no event exceed in the aggregate $17,600,000.

Sec. 14. In every contract or agreement to be made or entered into for the acquisition of land either by private sale or condemnation as in this Act provided the provisions contained in section 3741 of the Revised Statutes being section 22 of title 41 of the United States Code shall be applicable.

Approved, May 15, 1928.

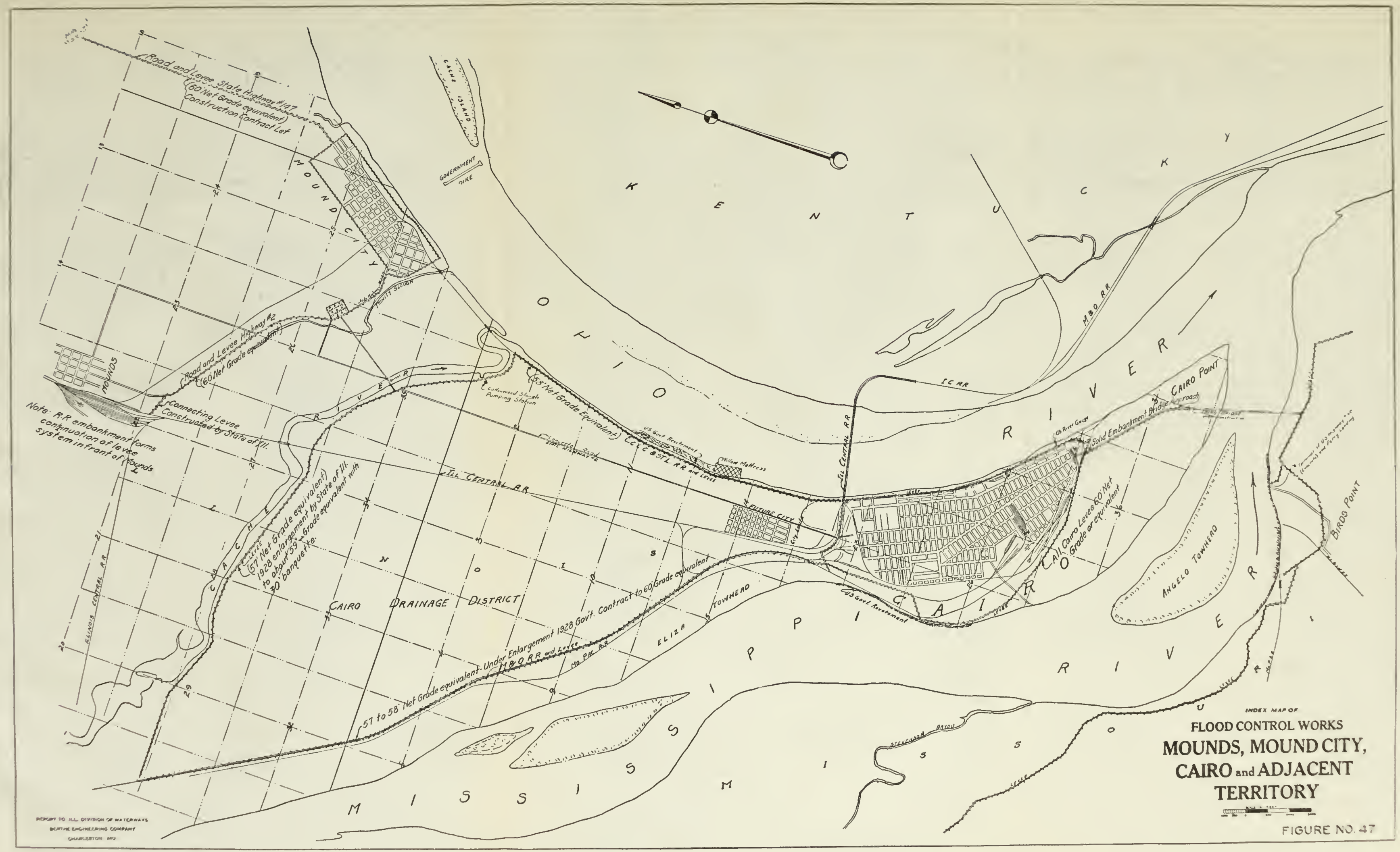

INDEX MAP OF
FLOOD CONTROL WORKS
MOUNDS, MOUND CITY, CAIRO and ADJACENT TERRITORY
KENTUCKY
OHIO RIVER
MISSISSIPPI RIVER
MISSOURI
ILLINOIS
CAIRO DRAINAGE DISTRICT
CACHE RIVER
MOUND CITY
MOUNDS
CAIRO
CAIRO POINT
BIRDS POINT
ANGELO TOWHEAD
ELIZA TOWHEAD
CACHE ISLAND
GOVERNMENT DIKE
FUTURE CITY
TRINITY SLOUGH
Road and Levee State Highway #147 (60' Net Grade equivalent) Construction Contract Let
Road and Levee Highway #2 (60' Net Grade equivalent)
Connecting Levee Constructed by State of Ill.
Note: R.R embankment forms continuation of levee system in front of Mounds
(57' Net Grade equivalent) 1928 enlargement by State of Ill. to about 59' Grade equivalent with 30' banquette.
Cottonwood Slough Pumping Station
(58' Net Grade Equivalent)
C.C.C. & St.L. R.R. and Levee
U.S. Govt. Revetment
Willow Mattress
ILL. CENTRAL R.R.
ILLINOIS CENTRAL R.R.
IC RR
M & O R.R.
Mo. PAC. R.R.
M & O R.R. and Levee
57 to 58' Net Grade equivalent. Under Enlargement 1928 Govt. Contract to 60' Grade equivalent
All Cairo Levee 60' Net Grade or equivalent
Solid Embankment Bridge Approach
U.S. River Gauge
REPORT TO ILL. DIVISION OF WATERWAYS
BURTHE ENGINEERING COMPANY
CHARLESTON, MO.

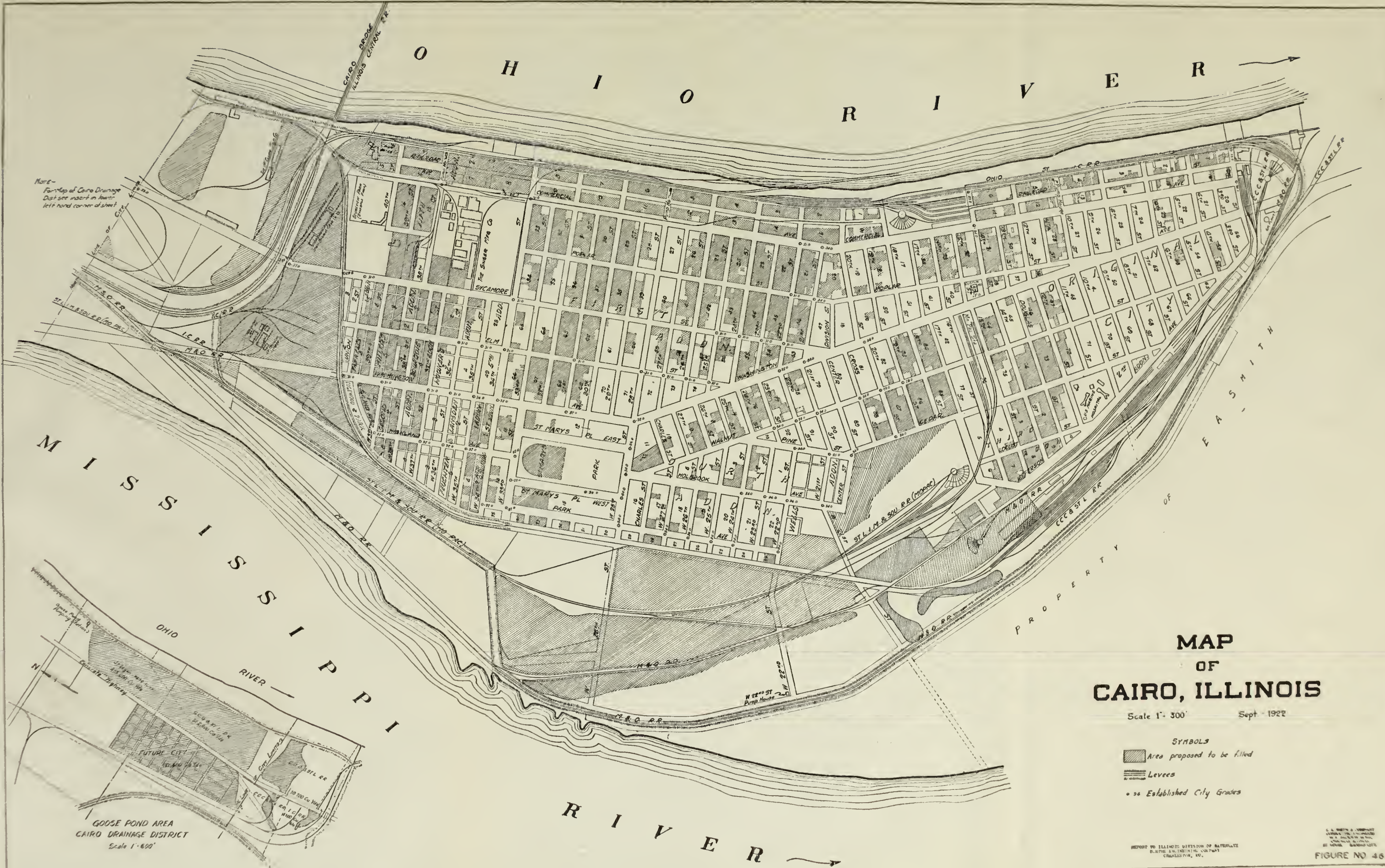
FIGURE NO. 47

THEBES
SANDUSKY
T. 15 S.
FAYVILLE
OLIVE BRANCH
UNITY
HODGES PARK
VILLA RIDGE
R 3 W
BURNHAM ISLAND
HORSE SHOE LAKE
Possible Alternative Mississippi River Levee
Levee to form subgrade of State Highway #150
PULASKI, CO.
MOUNDS
Approx. Location of Recommended Mississippi River Levee. Levee line in general to consist of river side of Railroad embankment
T 16 S.
MILLER CITY
ROTH
CACHE
MOUND CITY
ALEXANDER, CO.
SISTERS IS
RIVER
CACHE RIVER
MISSOURI
OHIO RIVER
MISSISSIPPI
T. 17 S.
R 1 W
R 2 W
CAIRO
INDEX MAP INDICATING
POSSIBLE ALTERNATIVE LOCATION
MISSISSIPPI RIVER LEVEE
ABOVE CACHE RIVER LEVEE, ILLINOIS

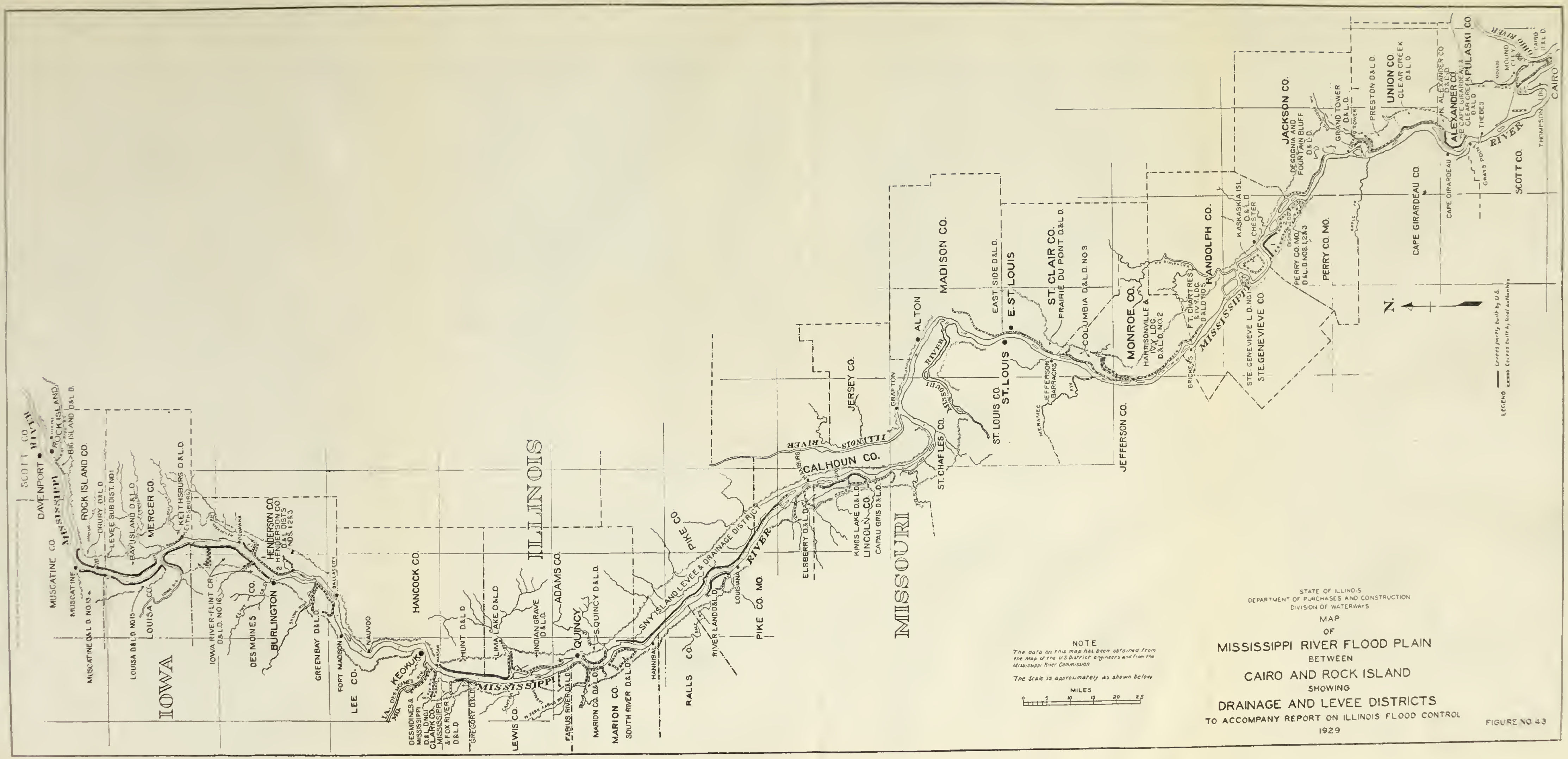
FIGURE NO. 48


KENTUCKY
OHIO RIVER
MISSISSIPPI RIVER
MISSOURI RIVER
ILLINOIS
CAIRO DRAINAGE DISTRICT
MOUND CITY
MOUNDS
CACHE RIVER
CACHE ISLAND
GOVERNMENT DIKE
SWAN POND
HUNTERS POND
Cottonwood Slough Pumping Station
Concrete Road
Seep Water 1922 Elev 39.4
ILL CENT R.R.
U.S. Govt Revetment 1923
Willow Mattress
C.C.C. & ST. L. R.R.
Goose Pond Pumping Sta.
FUTURE CITY
30 Sand Boils 1922
ILL CENTRAL R.R.
Dredge Site
I.C.R.R.
MOBILE & OHIO R.R.
Ohio Slides
Test Wells
U.S. River Gauge
CAIRO POINT
E.A. SMITH property
ANGELO TOWHEAD
BIRDS POINT
ELIZA TOWHEAD
U.S. Govt Revetment
M&O RR
Mo Pac R.R.
Sand Boils
Levee Slide Barbee's Crossing
STEVENSON
ILLINOIS CENTRAL R.R.
MAP OF CAIRO, ILL. AND VICINITY
SCALE IN FEET
REPORT TO ILLINOIS DIVISION OF WATERWAYS
BERTHE ENGINEERING COMPANY
CHARLESTON, MO.
C. E. SMITH & COMPANY
CONSULTING ENGINEERS
ST. LOUIS

FIGURE NO. 45



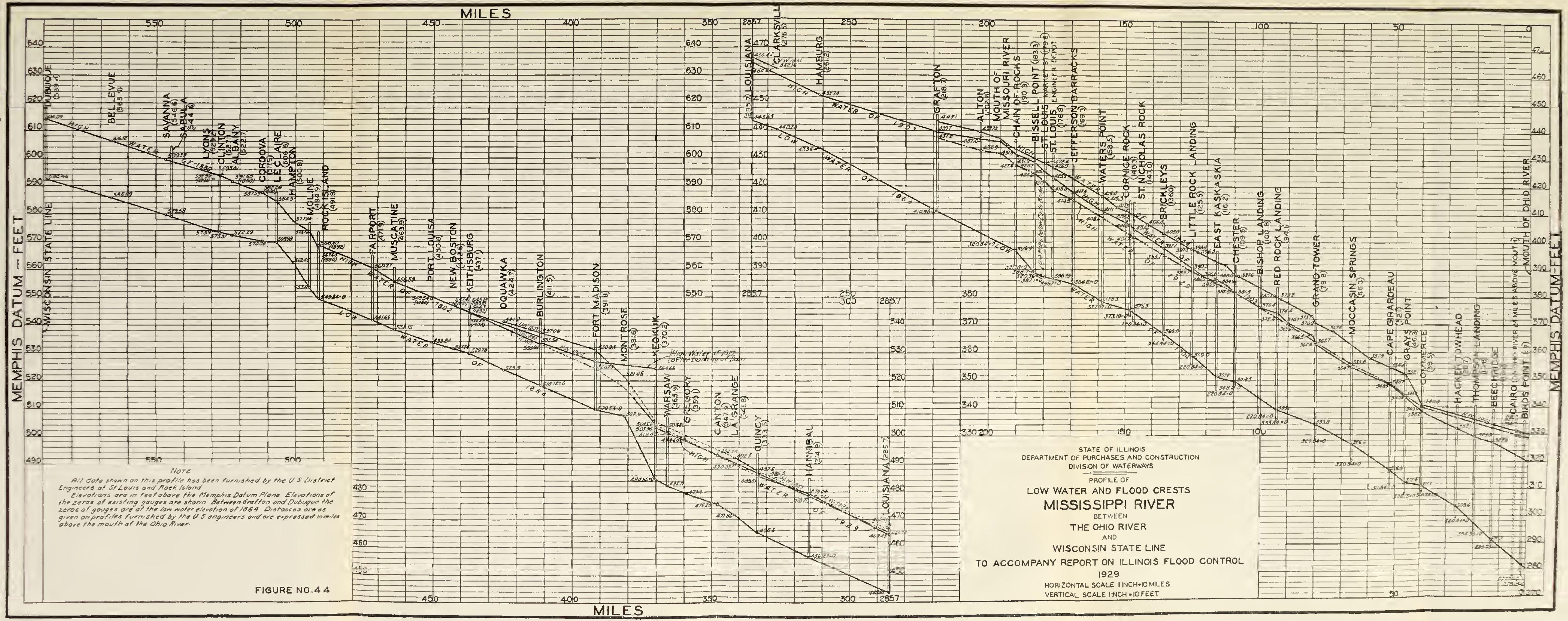
OHIO RIVER
MISSISSIPPI RIVER
CAIRO BRIDGE
ILLINOIS CENTRAL R.R.
PROPERTY OF E. A. SMITH
ST MARYS PARK
GOOSE POND AREA
CAIRO DRAINAGE DISTRICT
Scale 1" = 600'
MAP
OF
CAIRO, ILLINOIS
Scale 1" = 300'
Sept - 1922
SYMBOLS
Area proposed to be filled
Levees
• 36 Established City Grades
FIGURE NO. 46



STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS

MAP
OF
MISSISSIPPI RIVER FLOOD PLAIN
BETWEEN
CAIRO AND ROCK ISLAND
SHOWING
DRAINAGE AND LEVEE DISTRICTS
TO ACCOMPANY REPORT ON ILLINOIS FLOOD CONTROL
1929

FIGURE NO. 43



NOTE

All data shown on this profile has been furnished by the U.S. District Engineers at St Louis and Rock Island.
Elevations are in feet above the Memphis Datum Plane. Elevations of the zeros of existing gauges are shown. Between Grafton and Dubuque the zeros of gauges are at the low water elevation of 1864. Distances are as given on profiles furnished by the U.S. engineers and are expressed in miles above the mouth of the Ohio River.

FIGURE NO. 44

STATE OF ILLINOIS
DEPARTMENT OF PURCHASES AND CONSTRUCTION
DIVISION OF WATERWAYS

PROFILE OF
LOW WATER AND FLOOD CRESTS
MISSISSIPPI RIVER
BETWEEN
THE OHIO RIVER
AND
WISCONSIN STATE LINE
TO ACCOMPANY REPORT ON ILLINOIS FLOOD CONTROL
1929
HORIZONTAL SCALE 1 INCH = 10 MILES
VERTICAL SCALE 1 INCH = 10 FEET

APPENDIX "A."

RAINFALL STUDIES.

1. INTRODUCTION.

To obtain a clearer conception of the causes which produce floods on the Illinois River, a number of flood periods were studied in detail. Since it was not feasible to study all of the flood periods which have occurred, because of the large amount of work involved, nine of the larger ones were chosen for a detailed study. The following flood periods were selected: March to August, 1892; January to July, 1893; January to June, 1898; January to May, 1900; January to April, 1904; January to April, 1913; December 1915 to February 1916; October 1921 to April 1922; and August 1926 to June 1927.

The first phase of the study of each flood period was a determination of the amount of precipitation which caused the flood. The daily precipitation records which are published monthly by the United States Weather Bureau in "Climatological Data," were used for this purpose. Since the precipitation records previous to 1895 were not published, it was necessary to have copies of the original records for 1892 and 1893 made at the office of the Weather Bureau in Washington.

To discover the effect of the concentration of tributary flow upon the floods in the Illinois River Valley, it was necessary to obtain the precipitation over a number of the more important sub-watersheds. The tributary watersheds used are listed in Column 2 of Tables A-2 to A-10, Appendix A. In computing the average precipitation over each such watershed, the daily precipitation at each of the Weather Bureau's rainfall stations within and adjacent to the watershed were assigned weights, based upon the location of the station with respect to the boundary of the watershed. The precipitation at each station was considered as extending halfway to the adjacent stations. In this way each watershed was divided into a number of parts, each of which was covered by a precipitation station. The area of each part, as determined by planimeter, divided by the total area of the watershed, gave the weight to be assigned each precipitation station. These weights were expressed as percentages. In Table A-1, Appendix A, are given (1) the tributary watershed considered, (2) the precipitation stations used in computing the average precipitations over each watershed, and (3) the weights assigned each station for each of the nine flood periods studied. Since some of the stations were discontinued from time to time and new stations established, separate weights had to be used for each flood period. The average daily precipitations over each watershed were then computed by multiplying the daily precipitation at each station by the weight assigned that station, and adding the products.

In order that the distribution of precipitation over the different sub-watersheds might be studied more readily, the daily values were grouped by ten-day and monthly periods and are given in Tables A-2 to A-10, Appendix A. These condensed tables show the precipitation data for an entire flood period on one sheet, thus making it easier to study the distribution of rainfall by watersheds.

Table A-11, Appendix A, has been prepared to enable the reader to determine how much the monthly precipitations listed in Tables A-2 to A-10, Appendix A, are above or below normal. The normal precipitations are given for the northern division, the central division, and for the two divisions combined. The northern division, as defined by the Weather Bureau, includes all the precipitation stations to the north of an east and west line passing just north of Peoria. The central division includes all the stations south of this line and north of an east and west line passing just north of Grafton. In computing the normal precipitations for each division, the arithmetical average of the normal monthly precipitations at the various stations was taken.

The weighted daily precipitations are shown graphically in Figs. A-1 to A-37, Appendix A, respectively. Also, summation curves of monthly precipitation are shown on these figures; and above them, are platted the hydrographs of river stages.

The nine flood periods are analyzed in the following sections. Since the more recent floods have been the more disastrous, the floods have been considered in inverse order of their occurence.

2. ANALYSIS OF 1926-1927 FLOOD PERIOD.

The flood period from August 1926 to June 1927 was very unusual, not only because of the high river stages produced, but also because of the large number of days during which the river was above flood stage. The stages reached during October at Henry, Havana, and Beardstown were the highest which have ever been recorded. During the 11-month period the river at Morris was above flood stage for 56 days; at Peoria, 186 days; at Havana, 252 days; at Beardstown, 265 days; at Pearl, 260 days; and at Grafton, 92 days.

The average precipitation over the Illinois River watershed during this 11-month period was 45.90 in., which is the maximum which has ever been recorded over that watershed in a like period. The sub-watersheds over which the precipitation was above the average are as follows: Iroquois River, 47.55 in.; Vermilion River, 49.24 in.; Mackinaw River, 54.01 in.; Spoon River, 48.52 in.; Sangamon River, 52.99 in.; Macoupin Creek, 55.91 in.; Illinois River, Peoria to Havana, 51.11 in.; Illinois River, Havana to Beardstown, 49.22 in.; Illinois River, Beardstown to Pearl, 53.65 in.; and Illinois River, Pearl to Grafton, 54.44 in. Although the total precipitation for this period was far above normal, the precipitations for December, January and February were below normal, thus dividing the period into two major precipitation divisions, each of which produced extremely high stages.

During August 1926, the average precipitation over the Illinois River watershed was 3.97 in., which was about 0.60 in. above normal.

Of this total, 75 per cent occurred from August 1 to August 20. The ground was dry, however, at the end of the growing period and the August rains did not cause any appreciable rises in the river below La Salle. On the tributaries small rises resulted.

During September 1926, the average precipitation was 10.51 in., which is the record monthly precipitation for any month as far back as 1857. Over the following tributary watersheds the precipitation was above the average: Iroquois River, 10.76 in.; Vermilion River, 11.45 in.; Mackinaw River, 12.53 in.; Spoon River, 11.01 in.; Sangamon River, 13.14 in.; Macoupin Creek, 12.21 in.; Illinois River, Morris to Peoria, 11.01 in.; Illinois River, Peoria to Havana, 10.83 in.; Illinois River, Beardstown to Pearl, 14.10 in.; and Illinois River, Pearl to Grafton, 12.98 in.

Although there were only five days in September upon which no rain fell, the major portion fell during three storm periods. From September 1-9, 5.66 in. fell; from September 10-16, 1.41 in.; and from September 19-30, 3.44 in. The first of these storms produced the greatest rise and brought the river well above the flood stage at all points. The second storm increased the stages from one to two feet; but the river had receded to about its former stage when the third storm, followed immediately by the fourth storm of 2.58 in. during the first five days of October, brought the river to its maximum crest. The record stages reached were as follows: at Henry, 18.2 ft. on October 8-9; at Havana, 23.1 ft. on October 11, which was 0.6 ft. higher than the former record of April 1922; and at Beardstown, 26.25 ft. on October 12, which was 1.15 ft. higher than the record established in April 1922. The stage of 25.0 ft. at Peoria has been exceeded only by that of 1844. The particularly excessive rains over the Mackinaw, Sangamon, and Spoon Rivers, and over the Illinois River Valley between Peoria and Pearl account in part for the flood stages in this reach of the river being greater than those above and below.

As a result of the extremely high stages, the levees of the following Drainage and Levee Districts were either overstopped or broken; Banner Special, East Liverpool, Chautauqua, Kerton Valley, Langellier, Lacey, Otter Creek, West Matanzas, Hamm, Kelly Lake, Lost Creek, Meredosia, Little Creek, McGees Creek, Oakes, Mauvaisterre, Valley City, Scott County, Big Swan, Hillview, Fairbanks and Wilson. The total area flooded in these districts was approximately 100,000 acres.

Although the precipitation during October was only about 1.0 in. above normal, practically all of it fell during the first week and was the direct cause of the high flood stages reached during the second week in October. Following the peak stage, the river receded very gradually until about the middle of November; but for most or all of this period the river remained above flood stage.

Although the daily precipitations which caused the October flood are shown in the tables, it was thought worth while to present these data in pictorial form, and a storm map is presented in Fig. 8, (General Report) which shows by isohyetal lines the accumulated rainfall which produced this flood.

A storm period from November 13-19 produced 2.13 in. of rain and 0.65 in. of snow (water equivalent). The snow storm came on November 17-18. The rain raised the river at Peoria from a 15.0 ft. stage on November 13 to a 21.2 ft. stage on November 21; and at Beardstown, from a 14.5 ft. stage on November 13-14 to a 19.4 ft. stage on November 23. The snow which fell on November 17-18 did not melt until about November 23. The melting snow held the river at Peoria at a nearly constant stage until the end of the month; but at Beardstown, because of the discharge from the Sangamon River, the river rose to a 20.4 ft. stage on November 30. The river then fell slowly during December and January.

As previously stated, the precipitation during December and January was considerably below normal. Of the 1.08 in. precipitated during December, about one-half was in the form of snow, which did not remain on the ground for more than a few days. Also, most of the precipitation of 1.50 in. during January was snow. The largest daily snowfall was 0.93 in. (water equivalent) on January 13. These snows accumulated on the ground until about January 28 when a warm period began which continued until about February 8. On February 4-5, a rain of 0.81 in. melted the remaining snow and caused a sudden rise in the river. At Peoria, the rise was from a 13.7 ft. stage on January 31 to a 22.6 ft. stage on February 10; at Beardstown the river rose from an 11.9 ft. stage on February 1 to a 19.8 ft. stage on February 14. If the rain of February 4-5 had occurred a week earlier at the beginning of the warm spell, or if the rain had been greater—either of which events was highly probable—the stages reached in February would have been comparable with those reached in the preceding fall.

The March rainfall totaled 3.48 in. of which 2.61 in. fell between the 10th and the 20th. Although this rainfall was about 0.50 in. above normal, it was not at all unusual. A stage of 19.8 ft. was reached at Peoria on March 27, a stage of 17.6 ft. at Havana on March 28, and a stage of 20.5 ft. at Beardstown on March 28. These stages are not at all unusual for March.

During April, an average of 6.51 in. fell over the Illinois River watershed. This is about 90 per cent above normal. The high stages of the last week in March were maintained by 0.94 in. of rain on April 1, and 1.88 in. from April 2-14. From April 15-21 there was 2.74 in. of rain. These rains, coming when the river was at an 18.0 ft. stage at Peoria and a 22.0 ft. stage at Beardstown, caused a maximum stage of 24.7 ft. at Peoria on April 24, a 22.0 ft. stage at Havana on April 28, and a 25.2 ft. stage at Beardstown on April 26. The stages at Beardstown, Pearl and Grafton were the second highest of record. At Peoria and Havana the floods of October 1926 and April 1922 were somewhat higher than that of April 1927. The stages on the upper river were not unusual.

The river remained at a high stage for several weeks. By March 17 it had fallen to an 18.3 ft. stage at Peoria and a 19.4 ft. stage at Beardstown. These high stages were maintained by 1.34 in. of rain during the first ten days of May and 1.99 in. during the second ten

days. During the last ten days in May there was 2.53 in. of rain which caused a rise to a 24.0 ft. stage at Peoria and a 24.7 ft. stage at Beardstown on May 29.

In no other year of record has the Illinois River been above flood stage as often or for as long periods. There were three extreme flood periods, one of which was the highest of record for the stretch of river between Peoria and Beardstown. None of these floods was the result of one storm period, but of a series of storm periods following each other at such time intervals as to cause progressively higher river stages. All the rainfall studies show conclusively that at least three extended storm periods, following closely upon each other, or else heavy rains falling upon accumulated snow, are necessary to cause a big flood upon the Illinois River.

It is to be noted, also, that the total rainfall is not the only factor to be considered, and that the intensity of rainfall during each storm period and the time interval between storm periods are of perhaps equal importance. Since there is an endless number of combinations of these factors, it is to be expected that the same total rainfall will rarely produce the same flood stages.

3. ANALYSIS OF THE FLOOD OF APRIL 1922.

Between Havana and Valley City the stages reached in the April 1922 flood were the highest which had been recorded up to that time, exceeding even the flood of 1844. North of Havana and south of Valley City, the 1844 stages were considerably higher than those of 1922. At Pearl and Grafton the 1922 flood stages were the highest of record, exclusive of 1844.

At Morris a stage of 20.3 ft. was reached on April 12, the second highest stage ever reached. The highest stage was 22.9 ft. on January 22, 1916. The stage of 20.2 ft. at La Salle was exceeded in 1844, 1904 and 1916.

The stage of 24.8 ft. at Peoria on April 15, 1922, was exceeded by those of 1844 and 1926.

The 22.5 ft. stage at Havana on April 17-20, 1922, was exceeded by that of 1926 only.

The stage of 25.1 ft. at Beardstown on April 20, 1922, was exceeded by those of 1926 and 1927.

The stage of 23.0 ft. at Pearl on April 29, 1922, and the stage of 25.8 ft. at Grafton on April 20, have been exceeded by that of 1844 only.

The precipitation above La Salle for the period from October to December, 1921, was 9.03 in. which was 2.50 inches above normal. Above Peoria, the precipitation for the same period was 8.10 in.; above Havana, 8.51 in.; above Beardstown, 8.41 in.; and above Grafton, 8.08 in.

Not only was the precipitation during these three months above normal, but the distribution was rather unusual. At intervals of about seven to ten days, precipitations of from 0.50 to 0.75 in. occurred, which produced little or no flood run-off. The hydrographs during this period

show a remarkable uniformity of flow. This means that these rains were absorbed by the ground and replenished the ground-water storage, so that by the time cold weather set in the water content of the soil was unusually high. The January and February precipitations were about 1.0 in. below normal. During the latter half of January the precipitation was mostly in the form of snow, which accumulated on the ground. During February the precipitation was light and the temperature unusually mild. On or about February 19 the temperature rose above freezing. By the 22d the temperature records for that month were broken at a number of stations. It was the warmest February that had been experienced in Peoria in 67 years. The temperature remained high, the snow and the ice melted, and the smaller streams began to rise. Thus at the end of February, the saturated soil had started to give up its stored water. The March precipitation was from two to five inches above normal. The average over the Mackinaw watershed was 5.65 in.; over the Sangamon, 7.39 in.; over the Vermilion, 5.59 in.; over the Illinois River Valley from Peoria to Havana, 5.12 in.; and from Havana to Beardstown the average precipitation was 6.21 in. Although the total monthly precipitation was high, the individual daily rains were not. Over the watershed above Peoria, there were only three days on which the average precipitation was more than 0.50 in.; and the largest of these was 0.80 in. Over the Mackinaw and Sangamon River water sheds the precipitations were greater. Over the Mackinaw there were four daily rains in excess of 0.50 in., one of which amounted to 1.18 in. and another to 1.05 in. Over the Sangamon River watershed 2.51 in. of rain fell on March 14 and 1.19 in. on March 19.

Over many parts of the Illinois River watershed, especially the northern portion, the April precipitation was about normal. Over the Vermilion River watershed the excess was about 1.00 in.; over the Mackinaw River watershed it was 0.80 in.; over the Sangamon River watershed, 2.80 in.; and over the Illinois between Peoria and Beardstown the rainfall was about 0.50 in. above normal. There were only two days in April on which the precipitation over the watershed above Peoria exceeded 0.50 in. These were April 10th and 11th and the total precipitation was 1.67 in. Above Havana on these two days the precipitation was 1.50 in. Over the Sangamon River watershed there were five days with precipitation in excess of 0.50 in., the maximum being 1.12 in. on April 17.

The high stages at Peoria and Havana were due, therefore, to a high March and April precipitation distribution as to both quantity and time so as to produce a slow and steady rise of all the tributaries, and this caused a greater concentration at Peoria and points downstream than would have been the case if the precipitation had been more intense. The heavy run-off from the Mackinaw River watershed and from the Illinois Valley between Peoria and Havana caused the exceptional stage at Havana. The Beardstown stage was due primarily to the high discharge from the Sangamon River and also to the slow run-off from the lower river due to backwater from the Mississippi.

Whereas the 1926 and 1927 floods were due principally to the excessive precipitation, the April 1922 flood was due more to the distribution of a more moderate rainfall. From October 1921 to April 1922 all the factors which produce spring floods acted in conjunction, and the disastrous floods below La Salle resulted.

4. ANALYSIS OF FLOOD OF JANUARY 1916.

The 1916 flood was the result of excessive January precipitation combined with a sudden thaw and the melting of accumulated snow. For the State as a whole, the average precipitation during January was more than one inch greater than during any other January of record. The average precipitation over the watershed above Morris was 4.31 in., and the heavier precipitation over the lower portion of the Illinois River watershed increased the average to 5.41 in., for the entire watershed above Grafton.

The average precipitation during December 1915, was 1.75 in., which was mostly in the form of snow; but the snow did not remain more than a few days, as the warm rains removed it. The heaviest precipitation was over the Sangamon River and Macoupin Creek watersheds, and over the immediate watershed of the Illinois River below Peoria. The December rains and snows maintained an 11.0 ft. stage at Peoria, a 9.5 ft. stage at Beardstown, and an 11.0 ft. stage at Grafton.

On January 1 there was an average rainfall of 0.84 in. which started a rise that continued through the cold period from January 11-19. During this period, 1.50 in. of snow (water equivalent) fell and accumulated on the ground. On the evening of January 19, the temperature rose above 45 degrees and a warm rain began and continued until January 21. The total amount precipitated was 1.21 in. of which 0.84 in. fell on January 21. As a result of the rain, the melting snow and the rise in temperature, the Illinois Valley was immediately affected. Ice began to move in the streams and on some of the tributaries above La Salle it was necessary to dynamite incipient ice jams. The river at Morris crested on January 22 at a 22.0 ft. stage, which is the maximum stage ever reached at Morris. A contributing cause of this high stage was an ice jam at the Main Street bridge in Ottawa. The water at La Salle rose at an unusually high rate and from 7 a. m. on January 21st to 3 p. m. on the 22d, the river rose 11.7 feet. The crest stage of 24.0 ft. was reached on the afternoon of January 22. This is the maximum stage ever reached at La Salle. An ice jam at Henry contributed to this high stage.

The flood wave reached Peoria on January 25 and the highest stage was 23.1 ft., which was the highest stage reached at that place since 1844. This record has since been exceeded by the floods of 1922, 1926 and 1927. The river at Peoria did not remain at crest stage very long, but fell slowly.

The river at Havana did not crest until January 31, because of heavy rains over the Mackinaw and adjacent Illinois River watersheds during the last week in January. The crest stage at Havana was 19.5 ft. which was the highest reached up to that time.

The crest at Beardstown was reached on February 1-2 at a stage of 20.6 ft., which up to that time had been exceeded only in 1904. The river remained at a very high stage for about ten days, and was above the 15.0 ft. stage until March 1.

The crest of 19.8 ft. at Pearl was reached on February 2-3. This stage had been exceeded in 1904 and 1892. The river at Pearl remained at flood stage for about three days and then rapidly receded to a 15.0 ft. stage by February 15.

The river at Grafton crested at a 23.4 ft. stage on January 31–February 1, about two days before the crest at Pearl was reached, showing the effect of local precipitation. Fortunately, the Mississippi River was comparatively low, or else the stages on the lower Illinois would have been much higher.

The levees of the following Drainage and Levee Districts were breached and the districts flooded; Partridge, Hennepin, Meredosia, McGees Creek, Hartwell and Eldred.

Although the January precipitation was very unusual, yet only a portion of it affected the flood on the upper river. A thaw in the last of January or the first part of February is not so very unusual and is a fact of more or less common knowledge. Also, an accumulation of 1.50 in. of snow in January is not unusual and was exceeded in several of the nine years studied. Nor is a rainfall of 1.21 in. in three days an unusual occurrence. The snow, the rain and the rising temperature from a combination which occurs periodically. It is believed that a similar combination with either greater snowfall or greater rainfall, or both, is a probability which must be considered in predicting future late winter floods.

5. ANALYSIS OF FLOOD OF MARCH AND APRIL 1913.

The flood of March-April, 1913, was caused primarily by an average precipitation of 3.85 in. of rain from March 21-25, distributed as follows: 0.83 in. on March 21, 1.04 in. on March 23, 0.71 in. on March 24, and 0.77 in. on March 25. The secondary cause was the thaw which began on March 8 and melted 0.83 in. of accumulated snow. This melting snow saturated the ground and the surface run-off produced stages of 16.7 ft. at Peoria and 13.4 ft. at Beardstown, and thus prepared the way for the flood of the last of the month. Neither of these causes would have produced a large flood by itself, but acting in combination a large flood resulted. This flood is similar in its causes to that of 1916. The accumulated snow was not a maximum and the four-day precipitation of 3.85 in. was not unusual. If the same rain had occurred a week earlier, a much greater flood would have resulted. It is believed that a considerably larger flood than those of 1913 and 1916 is highly probable in the late winter or early spring as the result of a heavy three or four day rain coming at the same time as a sudden thaw and combining with the melting of an accumulation of snow. The total rain for March and April 1913 was 7.46 in. which is only slightly above normal for these months. The maximum precipitation for these two months during the 72 years for which records are available is 10.76 in.

A more detailed analysis of the 1913 flood is given below. During the four months preceding the flood period from January to April 1913 the precipitation was much below normal. There were deficits in rainfall of 0.80 in., 0.80 in., and 1.80 in. in September, November and December, respectively. In October the rainfall was 1.30 in. above normal. The deficit for the four-month period was, therefore, 2.10 in.

During January 1913 the total precipitation was 2.74 in. which was about 0.70 in. above normal. As shown in Table A-5, Appendix A, which gives the ten-day summations of precipitations, the precipitation over the Iroquois River watershed was 3.37 in.; over the Kankakee River watershed, 3.66 in.; over the Sangamon River watershed above Riverton, 4.60 in.; over the Macoupin Creek watershed, 4.17 in.; and over the Illinois River watershed between Pearl and Grafton, 4.85 in.

There were freezing temperatures from January 3-14. During this period 0.95 in. of snow accumulated on the ground. From January 15-20 the temperature rose and an unusually warm period set in. This was accompanied by light daily rains, aggregating 0.50 in., which started a rise in the river; and while the river was still rising, a rain of 0.56 in. on January 20 and one of 0.52 in. on January 23 continued the rise to a stage on January 25 about five feet above the low stage existing on January 1. On January 28 it turned very cold again and continued so until February 14. During this period light snows fell, totaling 0.31 in. From February 15-22 the weather was warm, but as there was only about 0.50 in. of rain, the river fell about two feet. On February 21-22, 0.84 in. of rain fell, which resulted in a rise of from one to two feet. Another cold spell occurred from February 23 to March 7, and during this period 0.83 in. of snow (water equivalent) fell. A thaw started on March 8 and the rise started which ended in flood stages during the last of the month. While the river was rising, as a result of the melting snow, light rains, aggregating 0.37 in. fell from March 13-16. At Peoria a stage of 16.7 ft. was reached on March 17; at Havana, 13.6 ft. on March 18-20; at Beardstown, 13.4 ft. on March 21; and at Pearl, 10.0 ft. on March 16-18. Up to this time the precipitation had been below normal. The melting snow, however, had saturated the ground. On March 19 a heavy storm period set in and by March 27, 3.84 in. of rain had fallen. On March 21, 0.83 in. fell and before all of this had run off, 2.52 in. fell from March 23-25, with 1.04 in. on the 23d. It was this heavy, but in no way unusual, rain which caused the 1913 flood.

The crest stages reached during this flood were as follows: at Morris, 18.3 ft. on March 28; at La Salle, 19.4 ft. on March 29; at Peoria, 22.3 ft. on March 30–April 2; at Havana, 19.9 ft. on April 4; at Beardstown 21.8 ft. on April 5; at Pearl, 20.2 ft. on April 5-9; and at Grafton, 20.5 ft. on April 11-12. A second rise on the lower river produced a maximum crest of 21.0 ft. at Pearl on April 13. The above stages below Havana were the highest ever reached up to 1913, with the exception of 1844. At Havana the same stage was reached in 1904. The stage of 22.3 ft. at Peoria was exceeded in 1844, 1904,

1916, 1922, 1926 and 1927. On the upper river the stages were not exceptional.

In comparing the several floods discussed it must be remembered that the flood heights of the several floods are not true indices of the comparative discharges, since, during the earlier floods, there were fewer leveed areas between Peoria and Pearl.

The conditions which caused the 1913 flood were in no way unusual and are likely to recur frequently.

6. ANALYSIS OF FLOOD OF MARCH—APRIL 1904.

The causes of the 1904 flood were similar to those of the 1913 and the 1916 floods, namely, high March rainfall acting in conjunction with a spring thaw.

The first storm period of the flood period from January to April 1904 occurred during the last week in January. The ground water at the time was somewhat below normal. In October 1903, the precipitation was normal; during November it was 1.29 in. below normal over the upper portion of the Illinois River watershed, and 1.61 in. below normal over the southern portion; during December there was also a deficit amounting to 0.45 in. over the northern and 0.62 in. over the southern portion of the watershed. Over the northern portion there was a fair covering of snow during the latter part of December, amounting to a water equivalent of 0.50 in.; whereas over the souther portion there was little snow on the ground at the end of December. The temperature during December was about 5 degrees below normal, which resulted in a small run-off for that month. The abnormally cold weather continued until January 20. During this time, the snow accumulation was about 0.60 in. On January 20 a two-day thaw, accompanied by 1.50 in. of rain, produced a rise in the river, varying from about nine feet at Morris to six feet at Beardstown. As shown in Table A-6, Appendix A, the precipitation was heaviest over the Iroquois and Vermilion watersheds and over the immediate valley of the Illinois River between Havana and Pearl. As most of the snow was on the upper watershed, the largest run-off came from that area. The flood peaks at Morris and La Salle were quite pronounced, reflecting the steeper slopes above these points. Below La Salle the effect of the flatter slopes and wider flood planes was quite evident. The maximum stage at Morris was 14.0 ft., at Peoria 16.3 ft., and at Beardstown 15.0 ft. On January 23 the temperature dropped below freezing and remained there until February 5. The cold weather had the effect of lowering the crest of the wave then passing down stream. During this second cold period, about 0.50 in. of snow accumulated on the ground. A two-day thaw set in on February 5. There was no rain, but the melting snow and ice caused a 5.5 ft. rise at Morris and a 2.0 ft. rise at Peoria, the gage at Peoria reading 16.6 ft. At Beardstown the river flowed at approximately a 15.0 ft. stage throughout February and to the third week in March. The weather turned cold about February 7 and remained below freezing until the last of the month. During this time about 1.0 in. of snow (water equivalent) collected on the surface. On the last day of Feb-

ruary, the weather moderated, and, during the daytime, temperatures of 40 to 50 degrees prevailed. The snow and ice melted, ran off, and produced a third period of high water during the first week of March. A 16.6 ft. stage was recorded at Morris on March 4 and a second peak of 15.4 ft. occurred on March 8. At Peoria there was only one crest, that of 18.5 ft. from March 11-13. This rise was caused by the melting of a comparatively small amount of snow and the liberation of a portion of the stored ground water. At Havana the river had been above the 13.0 ft. stage since January. It now rose to a 15.5 ft. stage on March 14-16. At Beardstown the river had maintained a still more uniform stage, and from March 7-21 the gage varied from 15.3 ft. by only a few tenths of a foot. The rise up to the middle of March had been caused by the usual spring thaw. During March there were only three days without rain, but most of the rains were light. From March 1-10 the total average precipitation above Beardstown was 0.45 in., of which 0.25 in. fell on March 6. From March 11-20 the total precipitation was 1.45 in., of which 0.54 in. came on March 14 and 0.57 in. on March 17. During the last eleven days of March, 3.16 in. of rain fell, distributed as follows: 0.36 in. on the 21st; 0.56 in. on the 22d; 0.35 in. on the 24th; 0.88 in. on the 25th; 0.45 in. on the 30th; 0.37 in. on the 31st; and smaller amounts on the days not listed. The result of this almost continuous rainfall was a flood stage of 20.2 ft. at Morris on March 26; at La Salle, a stage of 20.4 ft. on March 27; at Peoria, a flood stage of 23.0 ft. on March 28; and at Havana, the flood crest remained at a 19.9 ft. stage from March 31 to April 2. This prolonged stage was due to the prolonged tributary flow from the larger tributaries, particularly the Mackinaw River and Spoon River. The crest was reached at Beardstown on April 4 at a stage of 20.0; but the river was above the 19.5 ft. stage until April 10. The precipitation over the Sangamon River watershed was especially heavy. In 1904, very little drainage work had been done on the Sangamon River watershed and therefore the run-off was much slower than in 1916, 1922, 1926 and 1927. The delayed run-off from the Sangamon prolonged the flood stage at Beardstown. At Pearl a flood crest of 19.4 ft. was reached on April 6-7. At Grafton the flood peak was reached on April 2 at a stage of 19.9 ft. This stage was caused by the Mississippi and not by the Illinois River. The high stage of the Mississippi reduced the slope of Illinois River and increased the gage heights at Pearl and Beardstown. A second flood on the Mississippi River during the latter part of April caused a 24.0 ft. stage at Grafton.

The 1904 flood was a large one as far as total discharge is concerned, and the flood stages reached were the highest which had occurred since 1844, with the exception of the 1892 flood which produced a higher flood stage at Pearl; but because of the large amount of storage available in the flood planes at that time, the flood stages were considerably lower than in later floods which occurred after the drainage and levee districts had leveed most of the bottom lands below Peoria, thereby confining the river to a very narrow flood channel. Nevertheless, the stages on the upper river were quite high. The 1904 record at Morris was

not broken until 1916, and again in 1922. At La Salle the 1904 stage has been exceeded only by that of 1916.

The total precipitation for January, February and March 1904 was 9.33 in. This total has been exceeded twice in the 72 years of record.

7. ANALYSIS OF FLOOD OF MARCH 1900.

The flood of March 1900 was caused by the melting of a large amount of accumulated snow, unaccompanied by rain, following a previous thaw which had brought the river to about a 12.0 ft. stage at Peoria and an 11.5 ft. stage at Beardstown. These were moderately high stages in 1900. The 1900 flood is an example of an unusually large amount of snow, but no rain, causing a flood. If the March rainfall of either 1904 or 1913 had occurred in 1900, probably the largest flood in the history of the river would have resulted.

The flood period from January to April 1900 was unusual in that the monthly precipitations were in no way unusual. The rainfall during the preceding fall was below normal. The total precipitation for September, October, November and December was 9.43 in., which was 1.34 in. below normal. Although during December there was an average of about 0.60 in. of snow (water equivalent) precipitated, it did not remain long and by the end of the month the ground was bare. Because of the deficit of precipitation during the fall months, the ground-water supply was less than normal.

The January precipitation was only 1.25 in. which was about 1.0 in. below normal. The temperature during the middle of the month was unusually mild and the ground-water flow started early and caused rises of from about 4.0 ft. at Morris to about 1.5 ft. at Pearl. January began with cold weather and ended with cold weather, but much of the month was like spring in its warmth. On January 18 the ice in the river at Ottawa began to break up, but the river froze again on the 27th. By January 25 most of the frost was out of the ground.

From January 17-27 the river rose more or less steadily. The freezing weather which set in on January 27 caused the stream to recede somewhat at all stations except Havana, where the river continued to rise slowly. The cold weather continued during the first week in February and from February 3-6 about 0.70 in. of snow (water equivalent) collected on the surface. There was a warm period, February 7-8, with about 0.35 in. of rain on the 7th and 0.60 in. of rain on the 8th, small amounts in themselves, but, combined with snow, making a total of 1.58 in. which ran off very quickly and caused a 9.0 ft. rise at Morris, a 4.0 ft. rise at Peoria, and about a 2.0 ft. rise at Beardstown. Light rains from February 12-16, together with the ground water flow, maintained the river at about a constant stage. A rain of 0.50 in. on February 21 caused a small rise in the stream. On February 27 a great snow storm started and by the 28th 1.24 in. of snow (water equivalent) had fallen. This snowfall was reported as being the greatest since 1830-31. It was followed on March 5 by 0.63 in. of snow and on March 6 by 0.44 in. of snow (water equivalent). On March 9 a thaw began and the accumulated snow, totaling 2.50 in. started to melt. The

result was the maximum flood for 1900. The Peoria gage reached 19.9 ft. on March 16; the river at Havana crested at a 17.4 ft. stage on March 18; the crest passed Beardstown on March 19 at a 17.7 stage; at Pearl the maximum stage of 16.1 ft. was reached on March 22.

Table A-7, Appendix A, shows that the heaviest snowfall from February 27 to March 6 was centered over the watershed between Beardstown and Havana and over the Mackinaw and Sangamon river valleys. The run-off from this storm must have been as great as those of later years when higher stages were reached; but in 1900 the flow was not restricted by levees and the storage in the river valley was much greater.

The March flood of 1900 illustrates the effect of the melting of a large accumulation of snow. If the precipitations of March 5th and 6th had been in the form of rain, the run-off would have been much more rapid and the stages reached would have been much higher. So it is evident that a much more unfavorable combination of conditions might easily have occurred.

Below Beardstown the stages were lower than those above. In nearly all of the floods considered, the river at Pearl crested before the flood wave arrived from Beardstown. This will always be the case unless the Mississippi is at a high stage. In March 1900 the river at Grafton crested on the 16th, which was three days before a crest was reached at Beardstown. There were two rises at Grafton during April and May. These were caused by the Mississippi.

The total precipitation during January, February and March was only 7.60 in. which is only slightly above normal, but the precipitation of 4.33 in. in February was nearly 2.00 in. above normal; and it was this abnormal precipitation, largely in the form of snow, which was responsible for the 1900 flood.

8. ANALYSIS OF FLOOD OF MARCH AND APRIL 1898.

The flood of the first week of April 1898, was caused by three moderate storms coming the last three weeks of March and the melting of accumulated snow. None of the three storms was excessive, but the accumulation of snow was much greater than normal.

During the four-month period preceding January 1898, there was a deficit of rainfall amounting to about 2.50 in., and because of the unusually high fall temperature, the evaporation was above normal. The result was that the amount of water stored in the ground when freezing temperature set in was much less than normal.

On January 1, 1898, there was about 0.30 in. of snow on the ground over the northern division and about 0.55 in. over the central division. January was unusually warm, the average temperature being 5.5 degrees above normal. The precipitation also was above normal and varied from 3.30 in. over the watershed above Morris to 4.11 in. over the entire Illinois River watershed. The month started in with freezing temperatures and there was little melting of snow until about the 8th. A rain of from 0.78 in. to 1.20 in. from January 9-12 melted most of the snow then on the ground. Light snows fell from January 13-15 and remained on the ground until the 20th. On that day about 1.00

in. of rain melted the snow. The weather turned cold again and on January 22 an average of 0.83 in. of snow and rain fell. This was followed on January 25 by about 0.70 in. of snow over the northern division and rain over the central division. On January 26 a cold wave brought low temperatures which continued until February 3rd.

The temperature during February was about 2 degrees above normal. There were three cold periods. The first was the continuation of the January cold wave and was the most severe of the three periods. It lasted until February 3. The second cold period was on the 15th and 16th, and the third from the evening of the 23d to the morning of the 27th.

The total average precipitation during February was 2.06 in. over the area above Morris, and 2.23 in. for the entire watershed. There were only two rain periods of any moment. The first was on February 10-11 and 0.60 in. of rain fell; the second was from February 18-21 and gave a total of about 0.90 in., most of which was in the form of snow over the northern portion of the watershed. The rain on February 10-11 did not remove all the snow from the upper end of the watershed. The storm of February 19-21 covered the northern part of the watershed with about 12.0 in. of snow. Over the southern part of the watershed the ground was bare most of the month.

Both the temperature and the precipitation were above normal during March. The average temperature exceeded the normal by nearly 5 degrees. The average precipitation above Morris was 4.55 in.; and above Grafton it was 5.79 in. There were three storm periods during the month, namely 10-13, 18-22 and 26-27. During the first storm period, 1.34 in. of rain fell; during the second, 2.14 in.; and during the third, 1.94 in. The first storm produced a stage of 15.8 ft. at Peoria on March 17, a stage of 13.4 ft. at Beardstown on March 21, and a stage of 12.9 ft. at Grafton on March 15. The second storm raised the river at Peoria to a 17.4 ft. stage on March 23; at Beardstown to a 14.8 ft. stage on March 26; and at Grafton to a 17.2 ft. stage on March 23. The third storm was the most intense of the three and caused a maximum stage of 19.4 ft. at Peoria on April 1 and a stage of 19.9 ft. at Beardstown on the same day.

As far as flood stages are concerned, this flood was not nearly as severe as those which have followed in later years; but it furnishes an excellent illustration of how a flood is built up in successive stages by successive storm periods. In this instance there were three such storm periods. Had there been a fourth storm, a flood comparable with those of recent years would have resulted.

9. ANALYSIS OF FLOODS OF MARCH AND MAY 1893.

Complete temperature data were not available for this flood period, but at Urbana, Illinois, the main temperature for January was 14.8 degrees and the maximum temperature reached was 48 degrees. Also, the hydrographs show the river at a very low stage throughout January and well into February. The river was frozen over until about February 12.

The precipitation during January was somewhat above normal over the northern half of the watershed and below normal over the southern half, and below normal for the watershed as a whole. All of the precipitation, however, must have been in the form of snow, and by February 1, 2.07 in. of snow (water equivalent) had accumulated on the watershed above Peoria and 1.52 in. over the watershed above Grafton. By February 10 this amount had been increased to 3.54 in. above Peoria and 2.95 in. above Grafton. If these assumptions as to temperature are correct, the accumulated snow of February 1 was the maximum for any of the flood periods considered. Evidently a sudden rise in temperature began on February 12, and the melting snow and ice started a rise in the river. From February 13-18, 1.07 in. of rain fell over the Illinois River watershed. By February 24, the river at Peoria had reached a stage of 13.8 ft.—a rise of 9.2 feet. The river then fell about 0.8 ft. by March 1. Probably a drop of temperature was responsible for this fall. During the last ten days in February, the average precipitation above Peoria was only 0.57 in., but over the Iroquois River watershed there was 1.42 in. of rain during this period. Warmer weather during the first week in March caused a second rise from the melting of the snow which fell in January and February. The river would have crested at about a 16.0 ft. stage at Peoria on March 9, but 1.02 in. of rain on the 8th and 9th continued the rise to a maximum stage of 19.9 ft. on March 15. At Beardstown the stage was 17.0 ft. on March 14 and at Pearl the river crested at a 16.0 ft. stage on March 17.

The April rainfall was over 3.00 in. above normal. During the first ten days, 1.10 in. fell, and during the second and third ten-day periods the rain was 3.19 in. and 3.10 in., respectively. These heavy rains during the last half of the month produced a flood stage of 16.5 ft. at Peoria on May 6, a stage of 16.8 ft. at Beardstown on May 5, and a stage of 18.1 ft. at Pearl on May 4.

The March flood was due principally to the melting of the snow over the northern portion of the watershed, resulting in high flood stages on the upper river, but only moderate stages on the lower river. The May flood was caused by excessive precipitation during the last half of April. A study of Table A-9, Appendix A, shows that the heaviest precipitation was over the lower end of the watershed, and this fact is reflected in the hydrographs, as the river crested at Pearl on May 4, at Beardstown on May 5, and at Peoria on May 6. The flood of 1893 was the smallest, in so far as stages were concerned, of any of the nine floods considered.

10. ANALYSIS OF FLOODS OF MAY AND JUNE 1892.

Both of these floods were caused by excessive precipitation. The winter snows had melted and run off and the ground moisture was normal by the end of March. The March precipitation was only 2.32 in. which is about 0.50 in. below normal. During the first ten days of

April, 2.52 in. of rain fell, followed by 3.16 in. and 0.76 in. during the succeeding ten-day periods, respectively. The distribution of these rains over the watershed is shown in Table A-10, Appendix A. May was also a very wet month. During the first ten days, 3.46 in. of rain fell. Over the northern portion of the watershed the precipitation was much above this average value. The average rainfall over the Vermilion River watershed for this period was 5.72 in., and over the Illinois River Valley between Morris and La Salle it was 8.45 in. There were no gage readings at Morris and La Salle, but the flood stages must have been high. At Peoria the river rose from a 10.9 ft. stage on May 2 to a 21.9 ft. stage on May 9. The lower river did not crest until the middle of the month, during which time more rain fell. From May 10-20 an average of 2.57 in. fell over the entire watershed. These rains were very uniformly distributed over the entire area, and maintained a high stage on the river above Peoria, but produced no peak stages. Below Beardstown, however, the run-off from these rains combined with the flood wave from the upper river, due to the preceding storm, and caused high flood crests. At Beardstown the river rose to an 18.4 ft. stage on May 15, and at Pearl a stage of 20.4 ft. was recorded on May 19. This is the fifth highest stage ever reached at Pearl. Higher stages were recorded in 1844, 1922, 1926 and 1927.

Although the precipitation during the last ten days in May aggregated 3.07 in., no new flood crests resulted.

During June there were heavy rains over the watershed above Peoria. There was 11.89 in. of rain over the DesPlaines watershed, and the average for the watershed above Peoria was 8.66 in. High stages on the upper river was the result. The only record available, however, is that at Peoria, where a stage of 18.5 ft. was reached. The stages on the lower river were not unusual.

11. COMPARISON OF FLOOD STAGES.

In order that the magnitudes of the ten floods considered can be better compared as to flood stages, Table A-21, Appendix A, has been prepared. The numbers in parentheses directly over the flood stages indicate the order of magnitude of that stage with respect to the flood stages in other years at that station.

It will be noted that on the upper river the flood of 1916 produced stages from three to four feet higher than those reached in any other flood. This was due principally to ice jams. The second, third and fourth highest differ only slightly from each other.

Between Peoria and Beardstown, each of the later floods produced a high stage than that preceding. This does not mean necessarily that recent floods have been greater than former ones. The principal cause of this progressive increase in flood heights is the decrease in flood-plane storage resulting from the construction of levees. In 1904 there were few leveed areas along the river, whereas in 1926 nearly all of the bottom lands below Peoria had been included in drainage and levee districts.

TABLE A-21—MAXIMUM STAGES REACHED IN TEN FLOOD PERIODS.

Station.	Year.									
	1927	1926	1922	1916	1913	1904	1900	1898	1893	1892
Morris	(6) 19.2	(4) 20.0	(2) 20.3	(1) 22.9	(7) 18.3	(3) 20.2	(5) 19.4	(8) 16.5	------	------
LaSalle	(4) 20.1	(5) 20.0	(3) 20.2	(1) 24.0	(6) 19.4	(2) 20.4	------	------	------	------
Peoria	(3) 24.7	(1) 25.0	(2) 24.8	(4) 23.1	(6) 22.3	(5) 23.0	(8) 19.9	(9) 19.4	(8) 19.9	(7) 21.9
Havana	(3) 22.0	(1) 23.1	(2) 22.5	(5) 19.5	(4) 19.9	(4) 19.9	(7) 17.4	(6) 18.0	------	------
Beardstown	(2) 25.2	(1) 26.2	(3) 25.1	(5) 20.6	(4) 21.8	(6) 20.0	(9) 17.7	(7) 19.9	(10) 17.0	(8) 18.4
Pearl	(2) 22.7	(3) 22.1	(1) 23.0	(6) 19.8	(5) 20.2	(7) 19.4	(9) 16.1	(8) 18.3	(10) 16.0	(4) 20.4
Grafton	(2) 25.7	(3) 23.7	(1) 25.8	(4) 23.4	(5) 20.5	(6) 19.9	(8) 17.1	(7) 17.2	------	------

12. RELATION BETWEEN RAINFALL AND RISE OF RIVER.

A study was made to determine the relation between rises in the river and the rainfalls which produced them. With this end in view, all the rises in the river at Morris, La Salle, Peoria, Havana and Beardstown during the nine flood periods were taken from the hydrographs and tabulated in separate tables, together with the rainfalls which produced them. In many instances, it was uncertain as to just what rainfalls caused the rises and the conclusions reached and recorded were based entirely upon the judgment of the observer. Many of the discrepancies noted later are due to errors of judgment. Also, many of the spring rises were caused almost entirely by melting snow and ice, and it was impossible to determine how much of the accumulated snow had melted to produce a certain rise.

Each rise in feet divided by the corresponding rainfall in inches gave the rise in feet for each inch of rainfall. This ratio was a convenient basis of comparison and furnishes a means of estimating future flood heights for an assumed rainfall. These data are given in Tables A-12 to A-20, Appendix A. As will be observed there is a wide range in the ratios, although the majority are fairly uniform. The high and low ratios were expected, because of the extreme difficulty in determining the true amount of rain, or rain and melting snow, which caused a particular rise. In fact these extreme values might very justifiably have been omitted from consideration, but only two such values were omitted in computing the averages.

The ratios in Tables A-12 to A-20, Appendix A, were averaged and recorded in Table A-22, Appendix A. This table also shows maximum and minimum values and the number of items used in computing the averages. It is obvious from a glance at Tables A-12 to A-20, Appendix A, that one inch of rainfall has produced greater rises during the winter and spring, than during the summer and fall months. This is entirely logical, as the frozen ground in winter and the melting snow and ice in the spring assist in producing greater rises. It was decided to include the floods from December to April in one group and the remaining months in another group for Morris and La Salle. At Peoria, Beardstown, and Havana the month of April was included in the summer group.

Table A-22, Appendix A, is very significant. It is to be noted that at each of the five points on the river, one inch of summer and fall rains produce rises from 25 to 50 per cent less than those produced by one inch of winter and spring rains. This can be partly explained by the greater imperviousness of the ground in the winter and spring months, due to the frozen or saturated ground. Part of the explanation, however, lies in an underestimation of the rains which produced spring floods, as in nearly every instance some of the run-off was from rains which had fallen weeks or months before and were stored in the soil during the winter months.

It is also to be noted from Table A-22, Appendix A, that as the floods progress downstream, and the tributary watershed become greater, the rise per inch of rainfall becomes less. Thus for each inch of rainfall over the watershed above Morris, an average rise of 3.71 ft. has resulted at Morris; whereas at Beardstown the average rise per inch of rainfall is only 1.93 ft.

TABLE A-22—RISES IN FEET PRODUCED BY ONE INCH OF RAINFALL.

Station.	Season.	Number of rises.	Rise in feet per inch of rainfall.		
			Maximum.	Mean.	Minimum.
Morris	Dec.-Apr.	48	6.15	3.71	1.01
	May-Nov.	12	4.25	2.33	1.01
LaSalle	Dec.-Apr.	31	5.71	3.15	1.01
	May-Nov.	13	3.61	2.16	0.60
Peoria	Dec.-Mar.	40	5.09	2.42	1.00
	Apr.-Nov.	21	3.48	1.64	0.48
Havana	Dec.-Mar.	25	3.86	2.00	0.59
	Apr.-Nov.	14	4.28	1.38	0.32
Beardstown	Dec.-Mar.	23	3.61	1.93	0.68
	Apr.-Nov.	23	4.00	1.45	0.33

The rise in a stream at a given point is dependent upon, not only the total amount of rainfall, but also the distribution and intensity of that rainfall, and upon the imperviousness of the surface upon which the rain falls. Thus a rain of a given magnitude, falling upon frozen ground in the early spring, or at other times of the year upon ground which has been saturated by closely preceding rains, will produce a greater rise than a rain of the same magnitude falling upon the same watershed when the ground is dry. Although the condition of the ground surface during each of the storm periods was known with a fair degree of accuracy, this factor was not considered in computing the ratios in Tables A-12 to A-20, Appendix A. As many of the rises considered came as a part of a more extended rise, it can be assumed that in these instances the ground was practically saturated at the beginning of the storm which produced the final rise. There was no record, however, in any of the storm periods as to the distribution of rainfall during daily periods, and the difference in the intensities of the individual storms was the principal cause of the variations in rises through the middle ranges.

When all the foregoing factors are considered, the agreement between the individual ratios in Tables A-12 to A-20, Appendix A is as close as could have been expected.

TABLES.

TABLE NO. A-1—RAINFALL STATIONS AND THEIR WEIGHTS.
Based on areas covered—used in computing weighted average daily rainfall.

Ref. No.	Watersheds and rainfall stations.	Water-shed area, sq. mi.	Flood Periods.								
			1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas								
1	Iroquois above Chebanse	2,185									
	Roberts		11	11	14						
	Kankakee		7	8							
	Watseka		32	32						86	89
	Hoopeston		14	14	19	22	22				
	Collegeville, Ind		24	30	33	33					
	Wheatfield, Ind		4	5							
	Thayer, Ind		8								
	Martinton				34	40	40	70	87		
	Rantoul					5	5	9	13	7	
	Rennselaer, Ind						33				
	Winamac							12			
	Strawn							6			
	Valparaiso							3			11
	Hammond									2	
	LaFayette									5	
	Total		100	100	100	100	100	100	100	100	100
2	Kankakee above Momence	2,395									
	Kankakee		2	7							
	Thayer		15								
	Hobart		3	6							
	Valparaiso		10	11	31		23	26	23		55
	Wheatfield		12	20							
	Hamlet		18								
	LaPorte		10	16	16	18	20	21	13		
	South Bend		10	10	10	10	20	18	15		
	Plymouth		15	25	25	18					
	Goshen		2	2							
	Winona Lake		3	3	5	4					
	Knox					25			25		
	Martinton				7	11	8	8	7		
	Collegeville				6	14					
	Syracuse						7	7	3		
	Hammond						5	8		25	
	Rennselaer						17				
	Glennwood								9		
	Winamac							12			
	Warsaw								5		
	Michigan City									71	39
	Watseka									4	6
	Total		100	100	100	100	100	100	100	100	100
3	Kankakee, Momence to Custer Park	430									
	Kankakee		100	100							
	Manteno					82					
	Morris				4						
	Martinton				70	18	70	68	63		
	Joliet				26		30	20	11		
	Hammond							12		36	
	Glennwood								21		
	Dwight								5		
	Watseka									64	94
	Aurora										6
	Total		100	100	100	100	100	100	100	100	100

TABLE NO. A-1—Continued.

Ref. No.	Watersheds and rainfall stations.	Water-shed area, sq.mi.	Flood Periods. 1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas.								
4	Des Plaines above Joliet	835									
	Racine		12	4	4	4	4	18	7		
	Waukegan		30								
	Chicago		23	23	23		25				
	Elgin		17	24	24	18		6			
	Joliet		18	18	18	10	19	10	10		
	Antioch			31	31	32	36				
	LaGrange					36		26	26	42	42
	St. Charles						16				
	Ft. Sheridan							30	22	47	47
	Wheaton							10	13		
	Zion								22		
	Watseka									7	
	Aurora									4	4
	Waukesha										7
	Total		100	100	100	100	100	100	100	100	100
5	Des Plaines below Joliet	595									
	Elgin		16	16	16	6		4			
	Aurora		30	30	30		21	11	6	61	38
	Joliet		54	54	54	60	54	51	47		
	St. Charles					24	25	5	8		
	LaGrange					10				28	62
	Wheaton							26	29		
	Hammond							3		11	
	Oswego								5		
	Glennwood								5		
	Total		100	100	100	100	100	100	100	100	100
6	Illinois, Morris— Mouth Des Plaines Custer Park	1,135									
	Aurora		5	5	5			9		28	30
	Morris		26	26	27	22					
	Dwight		40	40	48	43			57		
	Kankakee		15	15							
	Joliet		14	14	20	7	43	45	28		
	Yorkville					10	16				
	Matena					18					
	Martinton						19	11			
	Ottawa						22	2		38	38
	Hammond							2		15	
	Strawn							9			
	Streator							22			
	Oswego								15		
	Watseka									19	21
	LaGrange										11
	Total		100	100	100	100	100	100	100	100	100
7	Fox above Algonquin	1,335									
	Elgin		8	7	7	7		11			
	Waukegan		12								
	Marengo		7	5							
	Williams Bay		40	29							
	Racine		4					11	5		
	Waukesha		29	29	38	38	38	37	30	33	33
	Antioch			30	50	50	53				
	Riley				5	5	6	1	5	12	12
	St. Charles						3		4		
	Ft. Sheridan							8	4	16	16
	Chemung							32	14		
	Delevan								25	39	39
	Zion								13		
	Total		100	100	100	100	100	100	100	100	100

TABLE NO. A-1—Continued.

Ref. No.	Watersheds and rainfall stations.	Water-shed area, sq.mi.	Flood Periods.								
			1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas.								
8	Fox, Algonquin-Dayton	1,135									
	Elgin		20	21	21	17		14			
	Sycamore		8	9	17	7	11	15	12	20	20
	Paw Paw		25	30		22					
	Ottawa		14		25	9	20	29	24	29	29
	Morris		4	10	4						
	Aurora		29	30	33		11	30	11	43	43
	St. Charles					17	25	11	24		
	Yorkville					28	30				
	Riley						3	1	2	8	8
	Oswego								22		
	Ashton								5		
	Total		100	100	100	100	100	100	100	100	100
9	Vermilion above Streator	1,055									
	Minonk		16	16	12	12	12	21	14		
	Pontiac		58	58	51	51	71				
	Roberts		26	26	26	26					
	Streator				11	11	11	20	16		
	Martinton						6		3		
	Strawn							59			
	Dwight								30		
	Lexington								34		
	Rantoul								3	12	
	Ottawa									28	29
	Watseka									24	30
	Bloomington									36	41
	Total		100	100	100	100	100	100	100	100	100
10	Vermilion above mouth	1,280									
	Pontiac		50	50	41	41	58				
	Roberts		22	22	21	21					
	Minonk		16	16	10	10	10	17	12		
	LaSalle		12	12	5	5	5				
	Streator				23	23	23	33	29		
	Martinton						4	2	2		
	Strawn							46			
	Ottawa							2	3	43	43
	Lexington								27		
	Dwight								24		
	Rantoul								3	9	
	Watseka									19	23
	Bloomington									29	34
	Total		100	100	100	100	100	100	100	100	100
11	Illinois, Morris to LaSalle	570									
	Morris		27	46	25	25					
	Dwight		5	5	3	3			15		
	Ottawa		38		43	42	63	89	78	100	100
	LaSalle		21	40	26	20	26				
	Paw Paw		9	9		8					
	Streator				3	2	6	11	5		
	Yorkville						5				
	Ashton								2		
	Total		100	100	100	100	100	100	100	100	100
12	Illinois, LaSalle to Peoria	1,610									
	Paw Paw		5	5		5					
	Walnut		10	10	11	10	11	15	13	37	39
	Tiskilwa		18	18	18	18	18	23	41		
	Henry		30	30	30	30	30	32			
	Peoria		9	9	9	9	9	10	12		
	Minonk		13	13	13	13	13	12	21		
	LaSalle		15	15	19	15	19				

TABLE NO. A-1—Continued.

Ref. No.	Watersheds and rainfall stations.	Water-shed area, sq. mi.	Flood Periods. 1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas.								
	Ottawa							6	5	27	27
	Streator							2	2		
	Ashton								4		
	E. Peoria								2	32	34
	Galva									4	
	Total		100	100	100	100	100	100	100	100	100
13	Illinois, Peoria to Havana	1,050									
	Peoria		60	60	60	60	68	65	42		
	Fairview		14	14	14	14					
	Havana		26	26	26	26	32	35	33	34	34
	East Peoria								25	66	66
	Total		100	100	100	100	100	100	100	100	100
14	Mackinaw above Green Valley	1,120									
	Peoria		25	25	25	25	27	26			
	Minonk		21	21	21	21	21	21	15		
	Lincoln		3	3	3	3					
	Bloomington		43	43	43	43	47	38	19	60	66
	Roberts		8	8	8	8					
	Rantoul						5			6	
	Strawn							15			
	Lexington								36		
	East Peoria								30	34	34
	Total		100	100	100	100	100	100	100	100	100
15	Spoon above Seville	1,580									
	Galva		40	36	38	37	27	26	28	53	
	Tiskilwa		6	6	6	6	6	6	8		
	Fairview		40	35	44	29					
	Macomb		8	3	6	3					
	Henry		4	4	4	4	5	4			
	Peoria		2	2	2	2		3	4		
	Monmouth			14		19	6	6	6		
	Knoxville						34	34	32		
	Bushnell						22	19	22	40	
	Havana							2		2	39
	East Peoria									5	61
	Total		100	100	100	100	100	100	100	100	100
16	Spoon below Seville	220									
	Fairview		28	28	28	28					
	Havana		34	34	34	34	50	52	64	64	100
	Astoria		26	26	26	26	20	19			
	Macomb		12	12	12	12					
	Bushnell						30	29	36	36	
	Total		100	100	100	100	100	100	100	100	100
17	Illinois, Havana to Beardstown	485									
	Havana		20	20	20	20	20	19	76	40	38
	Astoria		54	54	62	62	62	63			
	Rushville		10	10	18	18	18	18		56	62
	Beardstown		16	16							
	Alexander								5		
	Bushnell								19	4	
	Total		100	100	100	100	100	100	100	100	100
18	Sangamon above Monticello	590									
	Urbana		60	60	48	48	45				
	Roberts		25	25	25	25					
	Clinton		10	10	5	5					
	Bloomington		5	5	5	5	5	4	3	7	27
	Bement				17	17					

TABLE NO. A-1—Continued.

Ref. No.	Watersheds and rainfall stations.	Water-shed area, sq.mi.	Flood Periods. 1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas.								
	Rantoul						50	42	70	72	
	Monticello							40			
	Strawn							14			
	Lexington								7		
	Philo								15	15	73
	Decatur								5	6	
	Total		100	100	100	100	100	100	100	100	100
19	Sangamon above Riverton	2,710									
	Roberts		5	5	5	5					
	Urbana		13	13	10	10	10				
	Clinton		10	10	7	7					
	Decatur		24	24	21	25	27	21	33	31	
	Springfield		15	15	16	16	9	9	9	27	32
	Alexander		5	5	5	5					
	Morrisonville		16	16	16	24	15	16	23	21	
	Pana		12	12	12		12	11			32
	Bement				8	8					
	Rantoul						12	9	15	16	
	Loami						10	10	10		
	Mt. Pulaski						5	5	5		
	Monticello							15			
	Strawn							4			
	Philo								3	3	24
	Lexington								2		
	Bloomington									2	12
	Total		100	100	100	100	100	100	100	100	100
20	Sangamon below Riverton	2,755									
	Bloomington		16	16	16	16	28	25	29	36	42
	Clinton		16	16	16	16					
	Decatur		3	3	3	3	3	2	3	12	
	Lincoln		28	28	28	28					
	Havana		12	12	15	15	15	15	17	21	20
	Beardstown		4	4							
	Alexander		6	6	7	7	7	6	8		
	Springfield		15	15	15	15	14	16	14	29	36
	Mt. Pulaski						30	30	29		
	Astoria						3	3			
	Monticello							3			
	East Peoria									2	2
	Total		100	100	100	100	100	100	100	100	100
21	South Fork Sangamon above Taylorville	570									
	Decatur		10	10	10	30	10	13	31		
	Pana		54	54	54		54	50		100	100
	Morrisonville		36	36	36	70	36	37	69		
	Total		100	100	100	100	100	100	100	100	100
22	Beardstown to Pearl	1,620									
	Rushville		5	5	16	20	16	16		25	25
	Beardstown		19	19	19						
	Alexander		19	19	24	24	26	19	19		
	Whitehall		8	8	11	11				21	20
	Pearl		5	5							
	Griggsville		30	30	34	45	40	24	33	47	47
	Golden		14	14							
	Coatsburg						14	13	14		
	Carrollton						4				
	Winchester							28	32		
	Havana								2		
	Springfield									7	8
	Camp Point				15						
	Total		100	100	100	100	100	100	100	100	100

TABLE NO. A-1—Concluded.

Ref. No.	Watersheds and rainfall stations.	Water-shed area. sq.mi.	Flood Periods.								
			1926-27	1921-22	1915-16	1913	1904	1900	1898	1893	1892
			Per cents of sub-watershed areas.								
23	Crooked Creek above Ripley	1,265	------	------	------	------	------	------	------	------	------
	LaHarpe	--------	25	25	26	30	25	36	38	------	------
	Golden	--------	22	22	------	------	------	------	------	------	------
	Rushville	--------	15	15	17	29	16	28	------	45	67
	Macomb	--------	38	38	40	41	------	------	------	------	------
	Bushnell	--------	------	------	------	------	16	24	34	55	------
	Coatsburg	--------	------	------	------	------	7	12	25	------	------
	Fandon	--------	------	------	------	------	36	------	------	------	------
	Camp Point	--------	------	------	17	------	------	------	------	------	------
	Griggsville	--------	------	------	------	------	------	------	3	------	------
	Keokuk	--------	------	------	------	------	------	------	------	------	30
	Havana	--------	------	------	------	------	------	------	------	------	3
	Total	--------	100	100	100	100	100	100	100	100	100
24	Illinois, Pearl to Grafton	900	------	------	------	------	------	------	------	------	------
	Pearl	--------	15	15	------	------	------	------	------	------	------
	White Hall	--------	38	38	53	53	------	------	------	96	93
	Grafton	--------	33	33	33	33	------	43	------	------	------
	Alexander	--------	14	14	14	14	15	17	15	------	------
	Carrollton	--------	------	------	------	------	81	------	75	------	------
	Loami	--------	------	------	------	------	4	------	3	------	------
	Winchester	--------	------	------	------	------	------	36	7	------	------
	Carlinville	--------	------	------	------	------	------	4	------	------	------
	Springfield	--------	------	------	------	------	------	------	------	4	4
	Collinsville	--------	------	------	------	------	------	------	------	------	3
	Total	--------	100	100	100	100	100	100	100	100	100
25	Macoupin Creek near Kane	875	------	------	------	------	------	------	------	------	------
	Carlinville	--------	75	75	75	75	70	78	67	------	------
	White Hall	--------	12	12	12	12	------	------	------	87	68
	Grafton	--------	8	8	8	8	------	13	------	------	------
	Morrisonville	--------	5	5	5	5	5	5	5	------	------
	Carrollton	--------	------	------	------	------	25	------	25	------	------
	Loami	--------	------	------	------	------	------	4	3	------	------
	Pana	--------	------	------	------	------	------	------	------	13	------
	Springfield	--------	------	------	------	------	------	------	------	------	19
	Greenville	--------	------	------	------	------	------	------	------	------	13
	Total	--------	100	100	100	100	100	100	100	100	100

TABLE NO. A-2—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—August, 1926-June, 1927.																																	Total.
		Square miles.	Per cent.	August.			September.			October.			November.			December.			January.			February.			March.			April.			May.			June.			
						4.63			10.76			4.40			3.12			1.42			1.55			2.18			3.34			6.33			5.50			4.32	
1	Iroquois at Chebanse	2,185	8	1.13	1.92	1.58	5.86	1.64	3.26	2.93	0.32	1.15	0.65	1.94	0.53	0.82	0.00	0.60	0.12	1.29	0.14	1.37	0.41	0.40	0.41	2.92	0.01	1.52	3.31	1.50	0.75	2.79	1.96	1.37	1.21	1.74	47.55
						3.24			6.22			2.54			2.66			1.49			1.79			1.64			2.70			6.17			4.28			3.42	
2	Kankakee above Momence	2,395	9	0.65	2.01	0.58	2.26	1.45	2.51	1.56	0.26	0.72	0.86	1.37	0.43	0.57	0.22	0.70	0.33	1.37	0.09	0.64	0.56	0.44	0.55	1.92	0.23	1.74	2.78	1.65	0.72	1.41	2.15	1.81	0.53	1.08	36.15
						3.92			8.55			3.39			2.91			1.42			1.69			2.04			2.96			6.67			4.87			3.83	
3	Kankakee above Custer Park	5,010	18	1.00	2.26	0.66	3.55	1.64	3.36	2.21	0.27	0.91	0.76	1.69	0.46	0.71	0.13	0.58	0.21	1.36	0.12	1.10	0.50	0.44	0.49	2.36	0.11	1.71	3.42	1.54	0.73	2.05	2.09	1.68	0.85	1.30	42.25
						1.70			7.18			2.03			4.40			0.79			1.27			0.91			2.01			5.90			4.68			2.75	
4	Desplaines above Joliet	835	3	0.43	0.94	0.33	1.98	1.74	3.46	1.52	0.36	0.15	1.04	2.97	0.39	0.60	0.15	0.04	0.23	0.95	0.09	0.51	0.29	0.11	0.44	1.24	0.33	1.28	3.61	1.01	1.50	0.99	2.19	1.34	0.47	0.94	33.62
						1.59			7.15			1.91			4.47			0.79			1.23			0.95			2.08			6.56			4.87			3.09	
5	Desplaines above mouth	1,430	5	0.53	0.78	0.28	1.69	1.92	3.54	1.38	0.36	0.17	0.98	3.11	0.38	0.55	0.18	0.06	0.19	0.92	0.12	0.57	0.27	0.11	0.53	1.25	0.30	1.33	3.48	1.75	1.33	1.11	2.43	1.65	0.51	0.93	34.69
						3.74			9.33			2.13			4.15			0.99			1.46			2.56			2.42			7.62			4.98			4.05	
6	Ill., Morris, to mouth of Desplaines; Kankakee, mouth to Custer Park	1,135	4	1.68	1.67	0.39	4.01	1.97	3.35	1.66	0.16	0.31	1.01	2.89	0.25	0.65	0.14	0.20	0.13	1.28	0.05	1.63	0.37	0.56	0.68	0.66	1.08	1.53	3.96	2.13	0.80	1.84	2.34	2.54	0.77	0.74	43.43
						3.44			8.39			2.93			3.39			1.24			1.58			1.91			1.74			6.80			4.91			3.75	
7	Illinois above Morris	7,575	27	1.01	2.00	0.43	3.25	1.63	3.51	1.98	0.26	0.69	0.85	2.13	0.41	0.66	0.15	0.43	0.19	1.28	0.11	1.08	0.43	0.40	0.33	1.33	0.08	1.59	3.38	1.83	0.85	1.85	2.21	1.82	0.79	1.14	40.08
						2.28			5.96			2.87			4.05			1.01			1.33			1.36			2.45			5.04			5.09			2.57	
8	Fox above Algonquin	1,335	5	0.38	1.59	0.31	2.23	1.07	2.66	2.30	0.38	0.19	0.86	2.70	0.49	0.88	0.12	0.01	0.41	0.81	0.11	0.71	0.64	0.01	0.36	1.48	0.61	1.12	2.52	1.40	1.51	0.77	2.81	0.89	0.08	1.60	34.01
						2.46			7.21			2.44			4.65			0.82			1.17			1.32			2.31			5.64			4.88			2.60	
9	Fox above Dayton	2,530	8	0.68	1.35	0.43	2.20	1.68	3.33	1.93	0.35	0.16	0.90	3.33	0.42	0.68	0.12	0.02	0.29	0.77	0.11	0.82	0.43	0.07	0.40	1.49	0.42	1.26	2.85	1.53	1.26	0.97	2.65	1.06	0.25	1.29	35.50
						4.71			11.42			3.89			4.24			1.30			1.96			2.69			3.07			7.37			6.60			3.14	
10	Vermilion above Streator	1,055	4	2.57	1.78	0.36	5.78	1.32	4.32	3.08	0.26	0.55	1.00	2.97	0.27	0.83	0.06	0.41	0.19	1.57	0.20	1.35	0.59	0.75	0.70	2.30	0.07	2.17	3.76	1.44	0.96	3.46	2.18	1.74	1.11	0.29	50.39
						4.46			11.45			3.61			4.25			1.26			1.81			2.66			2.95			7.12			6.41			3.26	
11	Vermilion above mouth	1,280	5	2.46	1.76	0.24	5.57	1.52	4.36	2.86	0.26	0.49	1.00	3.02	0.23	0.82	0.07	0.37	0.18	1.47	0.16	1.38	0.58	0.70	1.67	1.22	0.06	2.11	3.56	1.45	0.99	3.26	2.16	1.89	1.06	0.31	49.24
						2.71			11.64			1.63			4.45			0.69			1.04			2.22			2.29			7.02			4.72			4.09	
12	Illinois, Morris to LaSalle	570	2	1.49	1.04	0.18	4.06	2.47	5.11	1.27	0.22	0.14	0.93	3.33	0.19	0.53	0.09	0.07	0.10	0.89	0.05	1.56	0.26	0.40	0.51	1.61	0.17	1.75	3.15	2.12	0.87	1.82	2.03	2.66	0.69	0.74	42.50
						3.32			8.63			2.78			3.74			1.09			1.46			1.89			1.94			6.57			5.04			3.38	
13	Illinois above LaSalle	11,955	42	1.14	1.69	0.49	3.30	1.65	3.68	1.99	0.26	0.53	0.83	2.54	0.37	0.64	0.14	0.31	0.20	1.16	0.10	1.09	0.45	0.35	0.37	1.44	0.13	1.55	3.27	1.75	0.96	1.80	2.28	1.67	0.65	1.06	39.84
						4.74			10.80			2.21			4.67			0.78			1.15			2.39			3.00			6.03			5.62			4.20	
14	Illinois, LaSalle to Peoria	1,610	6	1.80	2.13	0.81	5.16	2.36	3.28	1.81	0.20	0.20	0.98	3.51	0.18	0.64	0.08	0.06	0.10	0.98	0.07	1.36	0.38	0.65	0.42	2.30	0.28	1.75	2.78	1.50	1.53	2.19	1.90	2.54	0.84	0.82	45.59
						3.49			8.85			2.66			3.80			1.05			1.42			1.94			2.08			6.51			5.12			3.47	
15	Illinois above Peoria	13,565	48	1.22	1.85	0.42	3.50	1.72	3.63	1.96	0.24	0.46	0.83	2.65	0.32	0.63	0.14	0.28	0.19	1.13	0.10	1.12	0.44	0.38	0.38	1.56	0.14	1.58	3.21	1.72	1.03	1.87	2.22	1.77	0.67	1.03	40.30
						5.51			10.83			2.72			3.83			1.13			1.52			2.60			4.39			5.32			8.23			5.03	
16	Illinois, Peoria to Havana	1,050	4	1.85	0.91	2.75	7.28	1.52	2.03	2.31	0.15	0.26	0.70	2.69	0.44	0.80	0.09	0.24	0.05	1.30	0.17	1.00	0.63	0.97	0.48	3.35	0.56	1.48	3.38	0.46	1.18	4.59	2.46	2.81	1.76	0.46	51.11
						3.96			12.53			4.50			5.23			1.21			1.64			2.38			3.83			6.41			7.41			4.91	
17	Mackinaw above Green Valley	1,120	4	1.45	1.34	1.17	8.06	1.37	3.10	3.48	0.36	0.66	0.82	4.06	0.35	0.76	0.11	0.34	0.09	1.35	0.20	1.02	0.59	0.77	0.58	2.70	0.55	1.81	3.90	0.70	1.11	4.21	2.09	2.15	1.62	1.14	54.01
						4.74			11.09			2.30			4.40			0.96			1.15			2.31			3.14			6.09			7.70			4.66	
18	Spoon above Seville	1,580	6	2.25	1.33	1.16	7.19	2.07	1.83	1.77	0.39	0.14	0.83	3.24	0.33	0.71	0.07	0.18	0.04	1.05	0.06	1.19	0.42	0.70	0.34	2.67	0.13	1.84	3.07	1.18	1.88	3.17	2.65	2.16	1.66	0.84	48.54
						4.61			11.01			2.37			4.40			0.97			1.19			2.37			3.29			6.06			7.62			4.63	
19	Spoon above mouth	1,800	6	2.17	1.29	1.15	7.20	1.99	1.82	1.85	0.40	0.12	0.83	3.23	0.34	0.70	0.07	0.20	0.04	1.07	0.08	1.20	0.48	0.69	0.35	2.80	0.14	1.83	3.15	1.08	1.82	3.13	2.67	2.11	1.68	0.84	48.52
						3.69			9.41			2.75			3.94			1.07			1.41			2.04			2.57			6.38			5.59			3.75	
20	Illinois above Havana	17,535	62	1.34	1.73	0.62	4.37	1.71	3.33	2.07	0.26	0.42	0.82	2.81	0.31	0.67	0.14	0.26	0.14	1.16	0.11	1.11	0.44	0.49	0.46	1.81	0.30	1.63	3.21	1.54	1.10	2.24	2.25	1.89	0.93	0.93	42.60
						4.46			9.46			2.82			4.86			1.10			1.54			3.07			5.28			6.21			6.40			4.02	
21	Illinois, Havana to Beardstown	485	2	1.20	1.74	1.52	5.86	1.68	1.92	2.35	0.13	0.34	0.93	3.28	0.65	0.69	0.02	0.39	0.00	1.43	0.11	1.44	1.03	0.60	0.61	4.54	0.13	2.52	3.60	0.09	1.56	1.93	2.91	1.43	2.59	0.00	49.22
						4.94			13.13			5.32			3.55			1.01			1.94			1.02			4.75			6.87			6.00			4.30	
22	Sangamon above Riverton	2,710	10	1.29	1.99	1.66	8.60	0.82	3.71	4.31	0.33	0.68	0.61	2.50	0.44	0.29	0.12	0.60	0.07	1.44	0.43	0.33	0.37	0.32	0.57	3.78	0.40	3.22	3.47	0.18	1.32	1.53	3.15	0.97	2.30	1.03	52.83
						4.42			13.14			5.35			4.25			1.04			1.74			1.26			4.65			6.77			6.22			4.15	
23	Sangamon above mouth	5,465	19	1.06	1.74	1.62	8.62	0.97	3.55	4.37	0.39	0.59	0.64	3.16	0.45	0.47	0.10	0.47	0.06	1.31	0.37	0.52	0.41	0.33	0.76	3.50	0.39	2.80	3.79	0.18	1.33	1.86	3.03	1.10	2.18	0.87	52.99
						3.89			10.27			3.35			3.97			1.07			1.49			1.85			3.07			6.45			5.74			3.84	
24	Illinois above Beardstown	23,485	83	1.30	1.74	0.85	5.38	1.53	3.36	2.61	0.28	0.46	0.76	2.88	0.33	0.61	0.14	0.32	0.11	1.22	0.16	0.97	0.43	0.45	0.52	2.24	0.31	1.89	3.33	1.23	1.16	2.13	2.45	1.70	1.26	0.88	44.99
						4.73			14.10			4.55			4.06			1.32			1.54			1.21			6.47			6.20			5.62			3.85	
25	Illinois, Beardstown-Pearl	1,620	6	0.68	2.41	1.64	8.84	2.30	2.96	3.94	0.29	0.32	0.83	2.46	0.77	0.86	0.00	0.46	0.00	1.19	0.35	0.47	0.42	0.32	0.85	5.21	0.41	2.46	3.50	0.24	2.11	0.98	2.53	1.22	2.37	0.26	53.65
						4.12			10.22			2.78			3.63			1.14			1.38			1.55			4.72			5.25			5.55			4.44	
26	Crooked Creek above Ripley	1,265	4	1.10	1.81	1.21	6.66	1.67	1.89	2.09	0.49	0.20	0.81	2.40	0.42	0.87	0.00	0.27	0.01	1.18	0.19	0.66	0.48	0.41	0.53	3.73	0.46	1.53	3.02	0.70	1.57	2.01	1.97	1.79	2.65	0.00	44.78
						3.91			10.39			3.39			3.92			1.06			1.49			1.80			3.36			6.39			5.73			3.85	
27	Illinois above Pearl	26,370	93	1.24	1.77	0.90	5.62	1.55	3.22	2.65	0.30	0.44	0.75	2.80	0.37	0.62	0.13	0.31	0.10	1.22	0.17	0.92	0.43	0.45	0.55	2.48	0.33	1.89	3.34	1.16	1.23	2.04	2.46	1.68	1.30	0.87	45.29
						5.34			12.98			5.22			3.72			1.35			1.43			0.67			5.64			8.08			6.38			3.63	
28	Illinois, Pearl to Grafton	900	4	0.26	2.65	2.43	7.34	1.41	4.23	4.15	0.51	0.56	0.67	2.34	0.71	0.64	0.04	0.67	0.00	0.97	0.46	0.26	0.25	0.16	0.98	4.23	0.43	3.29	4.71	0.08	2.90	0.67	2.81	0.54	2.45	0.64	54.44
						4.30			12.21			4.82			4.08			1.61			1.68			0.81			5.19			8.67			8.72			3.82	
29	Macoupin Creek	875	3	0.22	2.51	1.57	5.59	2.05	4.51	3.14	0.57	1.11	0.64	2.82	0.62	0.49	0.14	0.98	0.02	0.99	0.67	0.24	0.38	0.19	1.01	3.66	0.52	4.91	3.75	0.01	3.44	0.97	4.31	0.44	2.91	0.47	55.91
						3.97			10.51			3.48			3.94			1.08			1.50			1.74			3.48			6.51			5.86			3.83	
30	Illinois above Grafton	28,145	100	1.17	1.83	0.97	5.66	1.56	3.29	2.61	0.27	0.60	0.76	2.78	0.40	0.61	0.13	0.34	0.10	1.21	0.19	0.87	0.42	0.45	0.54	2.61	0.33	2.00	3.40	1.11	1.34	1.99	2.53	1.70	2.13	0.00	45.90

TABLE NO. A-3—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—October 1921-April 1922.																					
		Square miles.	Per cent.	October.			November.			December.			January.			February.			March.			April.			Total.
						2.77			4.27			1.70			1.69			0.98			5.95			4.94	
1	Iroquois at Chebanse	2,185	8	1.20	0.32	1.25	0.28	3.58	0.41	0.39	1.11	0.20	0.73	0.68	0.28	0.21	0.23	0.54	0.34	2.85	2.76	1.38	3.10	0.46	22.30
						3.92			3.73			2.44			1.86			0.88			4.58			4.02	
2	Kankakee above Momence	2,395	9	1.43	1.17	1.32	0.47	2.70	0.56	0.81	1.54	0.09	0.98	0.70	0.18	0.28	0.23	0.37	1.14	0.98	2.46	0.73	2.91	0.38	21.43
						3.30			3.95			2.07			1.75			0.93			5.26			4.40	
3	Kankakee above Custer Park	5,010	18	1.29	0.84	1.27	0.37	3.08	0.50	0.61	1.32	0.14	0.86	0.80	0.09	0.28	0.23	0.42	1.08	1.56	2.62	0.98	3.05	0.37	21.66
						3.67			3.37			3.31			1.18			1.20			4.59			3.36	
4	Des Plaines above Joliet	835	3	1.01	1.31	1.35	1.45	1.63	0.29	1.25	1.94	0.12	1.02	0.12	0.04	0.30	0.05	0.85	0.67	1.07	2.85	1.43	1.76	0.17	20.68
						3.37			3.24			3.36			1.29			0.96			4.69			3.30	
5	Des Plaines above mouth	1,430	5	0.87	1.23	1.27	1.26	1.76	0.22	1.33	1.92	0.11	1.09	0.20	0.00	0.28	0.05	0.63	0.73	1.10	2.86	2.61	0.46	0.23	20.21
						2.57			3.45			2.70			1.40			0.88			5.02			3.94	
6	Ill., Morris to mouth of Des Plaines; Kankakee, mouth to Custer Park	1,135	4	0.72	0.76	1.09	0.50	2.81	0.14	1.19	1.42	0.09	1.01	0.24	0.15	0.24	0.24	0.40	0.66	1.56	2.80	1.73	1.65	0.56	19.96
						3.21			3.74			2.40			1.60			0.93			5.10			4.12	
7	Illinois above Morris	7,575	27	1.12	0.86	1.23	0.51	2.86	0.37	0.83	1.44	0.13	0.93	0.62	0.05	0.27	0.21	0.45	0.93	1.49	2.68	1.17	2.56	0.39	21.10
						4.46			2.19			3.18			0.87			1.73			2.52			2.48	
8	Fox above Algonquin	1,335	5	1.55	1.58	1.33	0.99	1.04	0.16	1.34	1.75	0.09	0.79	0.08	0.00	0.28	0.06	1.39	0.12	0.62	1.78	0.63	1.76	0.09	17.43
						3.75			2.46			3.31			1.07			1.25			3.16			2.38	
9	Fox above Wedron	2,530	8	1.08	1.41	1.26	0.94	1.38	0.14	1.47	1.76	0.08	0.96	0.09	0.02	0.28	0.05	0.92	0.45	0.70	2.01	0.76	1.46	0.16	17.38
						2.80			3.27			1.63			1.66			1.27			5.59			4.14	
10	Vermilion above Streator	1,055	4	1.22	0.56	1.02	0.43	2.68	0.16	0.61	0.97	0.05	0.92	0.52	0.22	0.26	0.41	0.60	0.87	2.28	2.44	1.18	2.22	0.74	20.36
						2.79			3.17			1.84			1.59			1.21			5.31			3.97	
11	Vermilion above mouth	1,280	5	1.11	0.62	1.06	0.45	2.57	0.15	0.79	1.03	0.02	0.91	0.46	0.22	0.25	0.38	0.58	0.76	2.18	2.38	1.25	2.02	0.70	19.88
						2.54			2.76			3.00			1.19			0.82			3.59			2.84	
12	Illinois, Morris to LaSalle	570	2	0.44	1.00	1.10	0.64	2.00	0.12	1.71	1.27	0.02	0.98	0.10	0.11	0.20	0.14	0.48	0.48	0.91	2.20	1.33	1.04	0.47	16.74
						3.21			3.30			2.52			1.46			0.99			4.60			3.63	
13	Illinois above LaSalle	11,955	42	1.07	0.94	1.20	0.58	2.45	0.27	1.01	1.43	0.08	0.93	0.36	0.17	0.27	0.19	0.53	0.79	1.34	2.47	1.08	2.18	0.37	19.71
						3.01			2.32			2.77			1.20			0.95			4.15			2.66	
14	Illinois, LaSalle to Peoria	1,610	6	0.48	1.01	1.52	0.46	1.79	0.07	1.73	1.00	0.04	0.99	0.14	0.07	0.22	0.19	0.54	0.79	1.04	2.32	1.36	0.77	0.53	17.06
						3.18			3.18			2.55			1.42			0.98			4.54			3.51	
15	Illinois above Peoria	13,565	48	1.01	0.94	1.23	0.56	2.37	0.25	1.10	1.37	0.08	0.94	0.44	0.04	0.27	0.19	0.52	0.80	1.31	2.43	1.11	2.00	0.40	19.36
						2.83			2.81			2.59			1.63			1.84			5.12			3.59	
16	Illinois, Peoria to Havana	1,050	4	0.74	0.75	1.34	0.50	2.15	0.16	1.67	0.79	0.13	1.43	0.05	0.15	0.35	0.57	0.92	0.69	1.80	2.63	1.36	1.51	0.72	20.41
						2.84			3.41			2.34			1.48			1.48			5.65			4.16	
17	Mackinaw above Green Valley	1,120	4	0.92	0.62	1.30	0.51	2.71	0.19	1.07	1.11	0.16	1.16	0.22	0.10	0.32	0.33	0.83	0.50	2.40	2.75	1.60	1.67	0.89	21.36
						2.58			1.74			2.20			1.64			1.55			3.87			3.11	
18	Spoon above Seville	1,580	6	0.44	0.86	1.28	0.26	1.33	0.15	1.22	0.90	0.08	1.40	0.14	0.10	0.30	0.24	1.01	0.76	1.08	2.03	1.44	1.17	0.50	16.69
						2.59			1.76			2.19			1.62			1.57			4.06			3.21	
19	Spoon above mouth	1,800	6	0.50	0.85	1.24	0.27	1.34	0.15	1.24	0.86	0.09	1.38	0.14	0.10	0.30	0.24	1.03	0.75	1.19	2.12	1.47	1.22	0.52	17.00
						3.03			3.01			2.47			1.44			1.09			4.56			3.49	
20	Illinois above Havana	17,535	62	0.91	0.87	1.25	0.53	2.28	0.20	1.15	1.23	0.09	1.02	0.37	0.05	0.28	0.21	0.60	0.62	1.50	2.44	1.16	1.87	0.46	19.09
						2.40			1.73			2.15			1.63			1.75			6.21			4.25	
21	Illinois, Havana to Beardstown	485	2	0.80	0.91	0.69	0.27	1.31	0.15	1.32	0.68	0.15	1.40	0.09	0.14	0.43	0.12	1.20	0.53	2.84	2.84	1.68	1.93	0.64	20.12
						2.12			4.29			2.42			1.47			1.00			8.28			7.07	
22	Sangamon above Riverton	2,710	10	0.93	0.31	0.88	0.36	3.77	0.16	0.52	0.72	1.18	0.94	0.36	0.17	0.41	0.04	0.55	0.74	4.67	2.87	2.59	3.93	0.55	26.65
						2.20			3.83			2.40			1.51			1.15			7.39			6.18	
23	Sangamon above mouth	5,465	19	0.87	0.42	0.91	0.47	3.22	0.14	0.68	0.90	0.82	1.04	0.29	0.18	0.40	0.04	0.71	0.65	3.90	2.84	2.42	3.08	0.68	24.66
						2.83			3.14			2.44			1.46			1.12			5.24			4.10	
24	Illinois above Beardstown	23,485	83	0.91	0.77	1.15	0.51	2.46	0.17	1.05	1.14	0.25	1.03	0.36	0.07	0.31	0.17	0.64	0.63	2.09	2.52	1.46	2.11	0.53	20.33
						2.37			2.12			2.20			1.54			1.19			5.63			6.14	
25	Illinois, Beardstown to Pearl	1,620	6	0.67	0.56	1.14	0.38	1.64	0.10	1.06	0.63	0.51	1.14	0.21	0.19	0.47	0.01	0.71	0.63	2.61	2.39	2.87	2.62	0.65	21.19
						3.01			1.54			1.73			1.14			1.76			4.69			4.24	
26	Crooked Creek above Ripley	1,265	4	1.02	0.91	1.08	0.23	1.13	0.18	1.07	0.50	0.16	0.96	0.09	0.09	0.41	0.19	1.16	0.80	1.33	2.56	2.47	1.27	0.50	18.11
						2.76			2.96			2.37			1.44			1.14			5.18			4.16	
27	Illinois above Pearl	26,370	93	0.85	0.77	1.14	0.48	2.32	0.16	1.04	1.08	0.25	1.03	0.33	0.07	0.31	0.16	0.67	0.62	2.07	2.49	1.55	2.11	0.49	20.01
						2.05			2.60			3.00			1.70			0.82			6.83			8.18	
28	Illinois, Pearl to Grafton	900	4	0.64	0.22	1.19	0.58	1.84	0.18	1.18	0.57	1.25	1.22	0.18	0.30	0.41	0.00	0.41	0.74	3.31	2.78	3.99	3.44	0.75	25.18
						1.46			4.07			2.79			1.32			1.01			8.28			9.47	
29	Macoupin above Kane	875	3	0.74	0.08	0.64	0.38	3.65	0.04	0.92	0.42	1.45	0.83	0.15	0.34	0.49	0.01	0.51	0.87	5.16	2.25	5.36	3.44	0.67	28.40
						2.70			2.99			2.39			1.44			1.12			5.31			4.42	
30	Illinois above Grafton	28,145	100	0.84	0.74	1.12	0.48	2.35	0.16	1.05	1.04	0.30	1.03	0.32	0.09	0.31	0.15	0.66	0.64	2.21	2.46	1.72	2.19	0.51	20.37

TABLE NO. A-4—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—December, 1915-February, 1916.									
		Square miles.	Per cent.	December.			January.			February.			Total.
						1.68			3.75			0.30	
1	Iroquois at Chebanse	2,185	8	0.02	0.87	0.79	0.94	1.39	1.42	0.16	0.02	0.12	5.73
						1.43			4.32			0.51	
2	Kankakee above Momence	2,395	9	0.19	0.51	0.73	1.07	1.46	1.79	0.19	0.12	0.20	6.26
						1.53			4.13			0.40	
3	Kankakee above Custer Park	5,010	18	0.10	0.68	0.75	0.99	1.47	1.67	0.16	0.07	0.17	6.06
						0.74			4.12			0.90	
4	DesPlaines above Joliet	835	3	0.01	0.41	0.32	0.93	1.59	1.60	0.39	0.09	0.42	5.76
						0.85			4.39			0.82	
5	DesPlaines above mouth	1,430	5	0.01	0.39	0.45	0.88	1.53	1.98	0.37	0.08	0.37	6.06
						1.31			4.86			0.40	
6	Ill., Morris to mouth of Des Plaines; Kankakee, mouth to Custer Park	1,135	4	0.04	0.64	0.63	0.74	1.26	2.86	0.12	0.07	0.21	6.57
						1.37			4.31			0.49	
7	Illinois above Morris	7,575	27	0.08	0.62	0.67	0.92	1.47	1.92	0.19	0.08	0.22	6.17
						0.51			3.61			1.31	
8	Fox above Algonquin	1,335	5	0.00	0.48	0.03	0.85	1.66	1.10	0.78	0.14	0.39	5.43
						0.61			3.78			1.02	
9	Fox above Wedron	2,530	8	0.01	0.39	0.21	0.82	1.41	1.55	0.55	0.09	0.38	5.41
						1.42			6.06			0.50	
10	Vermilion above Streator	1,055	4	0.01	0.87	0.54	1.30	2.06	2.70	0.16	0.06	0.28	7.98

						1.36			6.14			0.51	
11	Vermilion above mouth	1,280	5	0.02	0.82	0.52	1.25	2.01	2.88	0.15	0.07	0.29	8.01
						1.01			4.96			0.56	
12	Illinois, Morris to LaSalle	570	2	0.09	0.55	0.37	0.85	1.12	2.99	0.11	0.02	0.43	6.53
						1.21			4.43			0.62	
13	Illinois above LaSalle	11,955	42	0.07	0.60	0.54	0.92	1.49	2.02	0.28	0.08	0.26	6.26
						0.84			5.51			0.57	
14	Illinois, LaSalle to Peoria	1,610	6	0.09	0.46	0.29	0.93	1.41	3.17	0.19	0.02	0.36	6.92
						1.16			4.55			0.63	
15	Illinois above Peoria	13,565	48	0.08	0.59	0.49	0.91	1.49	2.15	0.27	0.08	0.28	6.34
						1.56			7.16			0.42	
16	Illinois, Peoria to Havana	1,050	4	0.07	0.91	0.58	1.56	3.56	2.04	0.34	0.06	0.02	9.14
						1.74			6.01			0.51	
17	Mackinaw above Green Valley	1,120	4	0.03	0.99	0.72	1.25	3.01	1.75	0.29	0.05	0.17	8.26
						0.93			5.84			0.39	
18	Spoon above Seville	1,580	6	0.25	0.39	0.29	1.02	1.29	3.53	0.23	0.02	0.14	7.16
						1.01			6.13			0.40	
19	Spoon above mouth	1,800	6	0.25	0.40	0.36	1.14	2.76	2.23	0.25	0.03	0.12	7.54
						1.22			4.96			0.59	
20	Illinois above Havana	17,535	62	0.07	0.63	0.52	0.99	2.66	1.31	0.28	0.06	0.25	6.77
						2.11			7.23			0.53	
21	Illinois, Havana to Beardstown	485	2	0.45	0.49	1.17	1.65	2.82	2.76	0.42	0.08	0.03	9.87
						3.20			6.20			1.02	
22	Sangamon above Riverton	2,710	10	1.10	0.78	1.32	2.83	0.51	2.86	0.49	0.10	0.43	10.42

TABLE NO. A-4—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—December, 1915-February, 1916.									
		Square miles.	Per cent.	December.			January.			February.			Total.
						2.82			6.14			0.93	
23	Sangamon above mouth	5,465	19	0.94	0.70	1.18	2.94	0.78	2.42	0.52	0.07	0.34	9.89
						1.59			5.28			0.66	
24	Illinois above Beardstown	23,485	83	0.06	0.86	0.67	0.98	2.69	1.61	0.34	0.05	0.27	7.53
						2.49			5.52			0.81	
25	Illinois, Beardstown to Pearl	1,620	6	0.03	1.23	1.23	0.66	2.55	2.31	0.51	0.05	0.25	8.82
						1.78			6.20			0.55	
26	Crooked Creek above Ripley	1,265	4	0.50	0.28	1.00	2.00	1.98	2.22	0.44	0.04	0.07	8.53
						1.66			5.34			0.67	
27	Illinois above Pearl	26,370	93	0.06	0.88	0.72	0.98	2.69	1.67	0.36	0.05	0.26	7.67
						2.57			6.01			1.31	
28	Illinois, Pearl to Grafton	900	4	0.00	1.24	1.33	0.49	2.62	2.90	0.57	0.12	0.62	9.89
						3.35			6.76			1.11	
29	Macoupin above Kane	875	3	1.28	0.65	1.42	0.48	2.54	3.74	0.53	0.15	0.43	11.22
						1.75			5.41			0.71	
30	Illinois above Grafton	28,145	100	0.06	0.93	0.76	0.96	2.69	1.76	0.38	0.05	0.28	7.87

TABLE NO. A-5—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—January, 1913-April, 1913.												
		Square miles.	Per cent.	January.			February.			March.			April.			Total.
						3.97			0.97			5.92			3.22	
1	Iroquois at Chebanse	2,185	8	1.50	1.85	0.62	0.38	0.00	0.59	0.25	0.87	4.80	2.19	0.47	0.56	14.08
						3.66			1.24			5.44			2.64	
2	Kankakee above Momence	2,395	9	1.34	1.69	0.63	0.25	0.10	0.89	0.55	0.50	4.39	1.84	0.09	0.71	12.98
						3.74			1.11			5.57			2.95	
3	Kankakee above Custer Park	5,010	18	1.39	1.72	0.63	0.30	0.06	0.75	0.39	0.40	4.78	2.29	0.01	0.65	13.37
						1.46			1.72			2.73			2.56	
4	DesPlaines above Joliet	835	3	0.73	0.10	0.63	0.01	0.01	1.70	0.18	0.57	1.98	2.17	0.00	0.39	8.47
						1.46			1.78			2.94			2.62	
5	DesPlaines above mouth	1,430	5	0.68	0.20	0.58	0.03	1.20	0.55	0.20	0.60	2.14	2.19	0.05	0.38	8.80
						2.07			1.74			3.88			2.44	
6	Ill., Morris to mouth of DesPlaines; Kankakee, mouth to Custer Park	1,135	4	0.80	0.70	0.57	0.14	0.03	1.57	0.24	0.42	3.22	2.21	0.00	0.23	10.13
						3.08			1.35			4.84			2.85	
7	Illinois above Morris	7,575	27	1.16	1.34	0.58	0.23	0.04	1.08	0.34	0.48	4.02	2.29	0.01	0.55	12.12
						1.60			1.34			2.74			2.80	
8	Fox above Algonquin	1,335	5	0.92	0.02	0.66	0.00	0.00	1.34	0.22	1.35	1.17	2.56	0.00	0.24	8.48
						1.32			1.76			2.96			2.79	
9	Fox above Wedron	2,530	8	0.67	0.07	0.58	0.00	0.02	1.74	0.17	0.82	1.97	2.60	0.00	0.19	8.83
						2.71			1.78			5.22			2.86	
10	Vermilion above Streator	1,055	5	0.70	1.34	0.67	0.25	0.03	1.50	0.46	0.52	4.24	2.42	0.07	0.37	12.57

TABLE NO. A-5—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—January, 1913-April, 1913.												
		Square miles.	Per cent.	January.			February.			March.			April.			Total.
						2.51			1.94			4.89			2.82	
11	Vermilion above mouth	1,280	5	0.66	1.14	0.71	0.22	0.04	1.68	0.41	0.54	3.94	2.41	0.06	0.35	12.16
						1.63			2.52			3.55			1.26	
12	Illinois, Morris to LaSalle	570	2	0.55	0.32	0.76	0.04	0.08	2.40	0.13	1.86	1.56	1.13	0.00	0.13	8.96
						1.56			1.52			4.30			2.70	
13	Illinois above LaSalle	11,955	42	0.98	0.98	0.60	0.15	0.03	1.34	0.28	0.56	3.46	2.13	0.14	0.43	10.08
						1.61			2.79			3.51			2.26	
14	Illinois, LaSalle to Peoria	1,610	6	0.66	0.24	0.71	0.12	0.02	2.65	0.20	0.31	3.00	1.87	0.33	0.06	10.17
						2.46			1.69			4.20			2.65	
15	Illinois above Peoria	13,565	48	1.04	0.80	0.62	0.14	0.03	1.52	0.26	0.58	3.36	2.27	0.00	0.38	11.00
						1.84			2.67			2.90			3.34	
16	Illinois, Peoria to Havana	1,050	4	0.72	0.65	0.47	0.20	0.18	2.29	0.20	1.27	1.43	3.23	0.05	0.06	10.75
						2.75			2.01			4.78			3.28	
17	Mackinaw above Green Valley	1,120	4	0.82	1.23	0.70	0.22	0.01	1.78	0.30	0.47	4.01	2.89	0.04	0.35	12.82
						1.48			2.45			3.76			2.56	
18	Spoon above Seville	1,580	6	0.68	0.20	0.60	0.14	0.01	2.30	0.21	0.75	2.80	2.56	0.00	0.00	10.25
						1.47			2.47			3.64			2.63	
19	Spoon above mouth	1,800	6	0.66	0.23	0.58	0.15	0.01	2.37	0.22	0.70	2.72	2.53	0.10	0.00	10.21
						2.36			1.85			4.10			2.72	
20	Illinois above Havana	17,535	62	0.95	0.80	0.61	0.13	0.03	1.69	0.24	0.59	3.27	2.39	0.00	0.33	11.03

						1.61			2.58			3.67			3.40	
21	Illinois, Havana to Beardstown	485	2	0.65	0.39	0.57	0.29	0.07	2.22	0.24	0.71	2.72	3.29	0.09	0.02	11.26
						4.60			1.21			6.26			3.41	
22	Sangamon above Riverton	2,710	10	1.06	1.29	2.25	0.38	0.02	0.81	0.26	0.38	5.62	2.54	0.19	0.68	15.48
						3.98			1.25			5.88			3.46	
23	Sangamon above mouth	5,465	19	1.10	1.86	1.02	0.37	0.00	0.88	0.23	0.43	5.22	2.72	0.17	0.57	14.57
						2.72			1.73			4.50			2.92	
24	Illinois above Beardstown	23,485	83	0.97	1.04	0.71	0.20	0.03	1.50	0.22	0.55	3.73	2.54	0.01	0.37	11.87
						2.45			1.82			4.84			3.28	
25	Illinois, Beardstown to Pearl	1,620	6	0.78	1.19	0.48	0.38	0.00	1.44	0.15	0.32	4.37	3.05	0.09	0.14	12.39
						1.06			2.44			3.24			3.03	
26	Crooked Creek above Ripley	1,265	4	0.50	0.11	0.45	0.23	0.00	2.21	0.27	0.40	2.57	3.00	0.01	0.02	9.77
						2.62			1.78			4.44			2.94	
27	Illinois above Pearl	26,370	93	0.93	0.99	0.70	0.21	0.05	1.52	0.21	0.52	3.71	2.59	0.01	0.34	11.78
						4.85			1.53			5.83			3.21	
28	Illinois, Pearl to Grafton	900	4	0.69	3.20	0.96	0.41	0.03	1.09	0.23	0.42	5.18	2.85	0.11	0.25	15.42
						4.17			1.19			6.01			3.25	
29	Macoupin Creek above Kane	875	3	1.50	1.87	0.80	0.33	0.01	0.85	0.35	0.44	5.22	2.80	0.09	0.36	14.62
						2.74			1.77			4.52			2.96	
30	Illinois above Grafton	28,145	100	0.95	1.06	0.73	0.21	0.05	1.51	0.23	0.50	3.79	2.60	0.01	0.35	11.99

TABLE NO. A-6—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—January, 1904-April, 1904.												
		Square miles.	Per cent.	January.			February.			March.			April.			Total.
						3.55			1.95			5.52			3.54	
1	Iroquois at Chebanse	2,185	8	0.18	1.94	1.43	0.26	0.51	1.18	0.52	1.12	3.88	1.16	0.13	2.25	14.56
						3.24			2.66			4.95			3.86	
2	Kankakee above Momence	2,395	9	0.19	1.62	1.43	0.70	0.44	1.52	0.51	1.45	2.99	1.52	0.42	1.92	14.71
						3.28			2.25			5.16			3.67	
3	Kankakee above Custer Park	5,010	18	0.18	1.76	1.34	0.46	0.49	1.30	0.51	1.27	3.38	1.32	0.25	2.10	14.36
						1.66			1.49			5.04			2.80	
4	DesPlaines above Joliet	835	3	0.27	1.03	0.36	0.15	0.41	0.93	0.65	2.55	1.84	0.94	0.20	1.66	10.99
						1.93			1.57			5.05			3.14	
5	DesPlaines above mouth	1,430	5	0.28	1.21	0.44	0.13	0.44	1.00	0.80	2.03	2.22	0.99	0.19	1.96	11.71
						2.31			1.63			4.74			3.94	
6	Ill., Morris to mouth of DesPlaines; Kankakee, mouth to Custer Park	1,135	4	0.26	1.48	0.57	0.11	0.40	1.12	0.88	1.15	2.71	1.12	0.13	2.69	12.62
						2.88			2.04			5.08			3.62	
7	Illinois above Morris	7,575	27	0.24	1.58	1.06	0.33	0.50	1.21	0.70	1.31	3.07	1.22	0.22	2.18	13.62
						0.77			1.06			5.13			2.15	
8	Fox above Algonquin	1,335	5	0.07	0.44	0.26	0.10	0.22	0.74	0.23	3.94	0.96	0.86	0.25	1.04	9.11
						1.36			1.36			5.06			2.94	
9	Fox above Wedron	2,530	8	0.12	0.73	0.51	0.09	0.35	0.92	0.88	2.42	1.76	0.93	0.18	1.83	10.72
						3.44			1.55			5.42			3.54	
10	Vermilion above Streator	1,055	5	0.40	1.84	1.20	0.22	0.11	1.22	0.68	1.21	3.53	1.50	0.03	2.01	13.95

						3.21			1.52			5.32			3.56	
11	Vermilion above mouth	1,280	5	0.34	2.40	0.47	0.19	0.17	1.16	0.67	1.22	3.43	1.57	0.06	1.93	13.61
						2.35			1.52			4.35			3.72	
12	Illinois, Morris to LaSalle	570	2	0.18	1.20	0.97	0.05	0.41	1.06	0.68	1.41	2.26	1.22	0.32	2.18	11.94
						2.58			1.82			5.07			3.48	
13	Illinois above LaSalle	11,955	42	0.20	1.43	0.95	0.25	0.43	1.14	0.62	1.63	2.82	1.21	0.20	2.07	12.95
						2.42			1.26			3.71			3.06	
14	Illinois, LaSalle to Peoria	1,610	6	0.19	1.70	0.53	0.11	0.35	0.80	0.22	1.15	2.34	0.97	0.09	2.00	10.45
						2.55			1.75			4.91			3.44	
15	Illinois above Peoria	13,565	48	0.20	1.47	0.88	0.21	0.43	1.11	0.65	1.48	2.78	1.19	0.19	2.06	12.65
						2.27			1.35			4.39			3.66	
16	Illinois, Peoria to Havana	1,050	4	0.40	0.83	1.04	0.08	0.82	0.45	0.30	1.31	2.78	1.01	0.00	2.65	11.67
						2.94			1.36			4.77			3.29	
17	Mackinaw above Green Valley	1,120	4	0.25	1.50	1.19	0.13	0.49	0.74	0.25	1.16	3.36	1.21	0.12	1.96	12.36
						2.84			0.52			3.71			2.57	
18	Spoon above Seville	1,580	6	0.14	2.08	0.62	0.12	0.12	0.28	0.06	1.04	2.61	0.76	0.01	1.80	9.64
						2.91			0.62			3.79			2.72	
19	Spoon above mouth	1,800	6	0.17	2.02	0.72	0.11	0.16	0.35	0.08	1.08	2.63	0.81	0.01	1.90	10.04
						2.60			1.56			4.78			3.37	
20	Illinois above Havana	17,535	62	0.21	1.49	0.90	0.16	0.43	0.97	0.53	1.43	2.82	1.13	0.16	2.08	12.31
						3.74			1.07			4.77			4.71	
21	Illinois, Havana to Beardstown	485	2	0.53	1.69	1.52	0.04	0.19	0.84	0.24	1.77	2.76	1.40	0.00	3.31	14.29
						2.77			1.37			6.99			4.48	
22	Sangamon above Riverton	2,710	10	0.29	0.87	1.61	0.31	0.58	0.48	0.61	1.34	5.04	1.51	0.12	2.85	15.61

TABLE A-6—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—January, 1904-April, 1904.												
		Square miles.	Per cent.	January.			February.			March.			April.			Total.
						2.87			1.34			6.04			4.54	
23	Sangamon above mouth	5,465	19	0.36	1.00	1.51	0.21	0.58	0.55	0.52	1.19	4.33	1.67	0.62	2.81	14.79
						2.68			1.51			5.06			3.66	
24	Illinois above Beardstown	23,485	83	0.29	1.35	1.04	0.17	0.46	0.88	0.51	1.39	3.16	1.25	0.14	2.27	12.91
						3.07			1.29			4.98			5.97	
25	Illinois, Beardstown to Pearl	1,620	6	0.56	1.77	0.74	0.21	0.68	0.40	0.28	1.30	3.40	1.32	0.28	4.37	15.31
						3.71			0.83			4.47			4.31	
26	Crooked Creek above Ripley	1,265	4	0.51	2.12	1.08	0.13	0.23	0.47	0.17	1.18	3.12	0.70	0.03	3.58	13.32
						2.77			1.46			5.03			3.83	
27	Illinois above Pearl	26,370	93	0.32	1.41	1.04	0.17	0.46	0.83	0.49	1.37	3.17	1.22	0.13	2.48	13.09
						2.21			0.46			5.54			6.93	
28	Illinois, Pearl to Grafton	900	4	0.36	0.27	1.58	0.04	0.15	0.27	0.29	0.79	4.46	1.58	0.54	4.81	15.14
						2.42			0.88			7.89			7.61	
29	Macoupin Creek above Kane	875	3	0.30	0.43	1.69	0.04	0.34	0.50	0.45	1.28	6.16	1.27	0.43	5.91	18.80
						2.75			1.41			5.17			4.05	
30	Illinois above Grafton	28,145	100	0.32	1.36	1.07	0.16	0.44	0.81	0.43	1.41	3.33	1.25	0.16	2.64	13.38

TABLE NO. A-7—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—January, 1900-May, 1900.															
		Square miles.	Per cent.	January.			February.			March.			April.			May.			Total.
						0.59			4.01			3.03			0.45			4.21	
1	Iroquois at Chebanse	2,185	8	0.00	0.59	0.00	1.44	0.52	2.05	1.44	0.35	1.24	0.00	0.36	0.09	1.49	1.40	1.32	12.29
						0.68			3.54			2.04			1.24			3.10	
2	Kankakee above Momence	2,395	9	0.26	0.32	0.10	1.34	0.45	1.75	1.16	0.34	0.54	0.03	1.01	0.20	1.33	0.76	1.01	10.60
						0.67			3.81			2.55			0.91			3.65	
3	Kankakee above Custer Park	5,010	18	0.24	0.37	0.06	1.40	0.50	1.91	1.30	0.33	0.92	0.02	0.75	0.14	1.43	1.07	1.15	11.59
						1.59			2.46			1.63			0.88			2.81	
4	DesPlaines above Joliet	835	3	0.15	1.44	0.00	1.42	0.20	0.84	1.09	0.03	0.51	0.11	0.77	0.00	1.73	0.61	0.47	9.37
						1.56			3.12			1.79			0.86			3.20	
5	DesPlaines above mouth	1,430	5	0.19	1.37	0.00	1.71	0.28	1.13	1.08	0.05	0.66	0.08	0.78	0.00	1.90	0.63	0.67	10.53
						1.39			4.08			2.60			0.99			3.88	
6	Ill., Morris to mouth of DesPlaines; Kankakee, mouth to Custer Park	1,135	4	0.29	1.10	0.00	2.09	0.39	1.60	1.22	0.10	1.28	0.02	0.95	0.02	1.81	0.97	1.10	12.94
						0.94			3.71			2.40			0.90			3.58	
7	Illinois above Morris	7,575	27	0.22	0.68	0.04	1.59	0.44	1.68	1.24	0.25	0.91	0.02	0.79	0.09	1.57	0.98	1.03	11.53
						1.54			2.88			1.26			1.65			1.59	
8	Fox above Algonquin	1,335	5	0.13	1.41	0.00	1.89	0.17	0.82	0.83	0.04	0.39	0.03	1.62	0.00	0.77	0.67	0.15	8.92
						1.62			3.40			1.71			1.41			2.70	
9	Fox above Wedron	2,530	8	0.18	1.44	0.00	1.94	0.34	1.11	1.00	0.05	0.66	0.05	1.36	0.00	1.32	0.93	0.45	10.84
						1.14			3.69			2.46			1.14			3.37	
10	Vermilion above Streator	1,055	5	0.21	0.93	0.00	1.79	0.28	1.62	1.11	0.21	1.14	0.05	1.09	0.00	0.97	1.01	1.39	11.80

TABLE NO. A-7—Concluded.

Ref. No.	Watershed.	Areas. Square miles.	Areas. Per cent.	Flood period—January, 1900-May, 1900. January.			February.			March.			April.			May.			Total.
						1.20			3.69			2.56			1.19			3.24	
11	Vermilion above mouth	1,280	5	0.24	0.96	0.00	2.27	0.14	1.28	1.14	0.17	1.25	0.04	1.13	0.00	0.99	0.94	1.31	11.88
						1.60			4.43			2.91			1.49			5.25	
12	Illinois, Morris to LaSalle	570	2	0.33	1.24	0.03	2.04	0.69	1.70	1.27	0.09	1.55	0.06	1.43	0.00	2.55	1.47	1.23	15.68
						1.14			3.67			2.31			1.07			3.44	
13	Illinois above LaSalle	11,955	42	0.23	0.89	0.02	1.74	0.40	1.53	1.19	0.18	0.94	0.03	0.97	0.07	1.52	0.97	0.95	11.63
						1.73			3.66			3.03			1.50			4.38	
14	Illinois, LaSalle to Peoria	1,610	6	0.27	1.46	0.00	1.62	0.37	1.67	1.15	0.06	1.82	0.13	1.29	0.08	1.21	1.79	1.38	14.30
						1.20			3.67			2.40			1.13			3.55	
15	Illinois above Peoria	13,565	48	0.23	0.95	0.02	1.73	0.40	1.54	1.19	0.17	1.04	0.04	1.01	0.08	1.49	1.07	0.99	11.95
						1.91			4.93			1.18			1.06			4.06	
16	Illinois, Peoria to Havana	1,050	4	0.52	1.39	0.00	2.07	0.31	2.55	0.28	0.04	0.86	0.01	0.95	0.10	0.97	1.81	1.28	13.14
						1.39			5.36			2.32			1.40			4.89	
17	Mackinaw above Green Valley	1,120	4	0.36	1.03	0.00	2.15	0.34	2.87	0.94	0.20	1.18	0.06	1.20	0.14	1.05	1.92	1.92	15.36
						1.89			3.40			2.82			1.42			4.07	
18	Spoon above Seville	1,580	6	0.28	1.61	0.00	1.67	0.11	1.62	1.27	0.04	1.51	0.08	1.09	0.25	1.21	1.82	1.04	13.60
						1.89			3.74			2.58			1.42			3.86	
19	Spoon above mouth	1,800	6	0.29	1.60	0.00	1.75	0.14	1.85	1.19	0.04	1.35	0.07	1.09	0.26	1.14	1.80	0.92	13.49
						1.31			3.85			2.35			1.17			3.70	
20	Illinois above Havana	17,535	62	0.26	1.03	0.02	1.79	0.36	1.70	1.13	0.15	1.07	0.03	1.02	0.12	1.41	1.24	1.05	12.38

						2.01			6.71			1.10			1.01			2.46	
21	Illinois, Havana to Beardstown	485	2	0.25	1.76	0.00	2.45	0.29	3.97	0.87	0.03	0.20	0.02	0.97	0.02	1.07	1.35	0.04	13.29
						0.51			4.85			1.48			1.10			3.73	
22	Sangamon above Riverton	2,710	10	0.05	0.46	0.00	1.94	0.24	2.67	1.12	0.07	0.29	0.02	0.57	0.51	1.56	1.41	0.76	11.67
						0.76			5.12			1.51			1.20			3.52	
23	Sangamon above mouth	5,465	19	0.10	0.66	0.00	1.80	0.26	3.06	1.12	0.09	0.30	0.02	0.73	0.45	1.32	1.47	0.73	12.11
						1.19			4.19			2.12			1.18			3.35	
24	Illinois above Beardstown	23,485	83	0.21	0.96	0.02	1.81	0.33	2.05	1.12	0.14	0.86	0.01	0.86	0.31	1.29	1.41	0.65	12.93
						1.29			5.16			1.38			1.43			3.91	
25	Illinois, Beardstown to Pearl	1,620	6	0.04	1.25	0.00	1.85	0.67	2.64	1.14	0.11	0.13	0.01	0.74	0.68	1.58	1.72	0.61	13.17
						2.16			5.40			1.20			1.60			3.81	
26	Crooked Creek above Ripley	1,265	4	0.42	1.74	0.00	1.88	0.32	3.20	0.94	0.01	0.25	0.00	1.16	0.44	1.32	1.70	0.79	14.17
						1.24			4.33			2.03			1.22			3.43	
27	Illinois above Pearl	26,370	93	0.20	1.03	0.01	1.83	0.35	2.15	1.12	0.14	0.77	0.01	0.88	0.33	1.33	1.44	0.66	12.25
						0.87			4.71			1.83			1.29			3.97	
28	Illinois, Pearl to Grafton	900	4	0.02	0.85	0.00	1.59	0.24	2.88	1.43	0.16	0.24	0.00	0.60	0.69	1.78	1.39	0.80	12.67
						0.61			4.76			1.72			1.33			4.80	
29	Macoupin Creek above Kane	875	3	0.04	0.57	0.00	1.95	0.06	2.75	1.43	0.07	0.22	0.00	0.51	0.82	3.13	0.66	1.01	13.22
						1.25			4.33			2.02			1.23			3.48	
30	Illinois above Grafton	28,145	100	0.21	1.03	0.01	1.81	0.34	2.18	1.15	0.14	0.73	0.01	0.87	0.35	1.39	1.41	0.68	12.31

TABLE NO. A-8—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—January, 1898-June, 1898.																		
		Square miles.	Per cent.	January.			February.			March.			April.			May.			June.			Total.
						3.44			1.88			4.77			1.99			5.69			2.95	
1	Iroquois above Chebanse	2,185	8	0.31	0.95	2.18	0.17	1.55	0.16	0.51	1.65	2.61	0.20	0.87	0.92	0.78	3.22	1.69	1.19	0.93	0.83	20.72
						2.59			1.92			5.05			1.21			3.32			3.50	
2	Kankakee above Momence	2,395	9	0.22	1.38	0.99	0.48	1.12	0.32	0.27	3.04	1.74	0.21	0.37	0.63	0.81	1.60	0.91	0.93	0.78	1.79	17.59
						3.02			1.91			4.91			1.61			4.50			3.25	
3	Kankakee above Custer Park	5,010	18	0.26	1.67	1.09	0.29	1.30	0.32	0.37	2.35	2.19	0.22	0.62	0.77	0.79	2.41	1.30	1.04	0.88	1.33	19.20
						3.62			2.56			4.67			1.70			3.09			4.83	
4	DesPlaines above Joliet	835	3	0.10	1.82	1.70	0.24	1.99	0.33	0.31	2.80	1.56	0.54	0.92	0.24	0.63	1.34	1.12	1.20	1.51	1.92	20.27
						3.76			2.47			5.12			1.57			3.51			5.42	
5	DesPlaines above mouth	1,430	5	0.09	2.03	1.64	0.31	1.90	0.26	0.25	3.06	1.81	0.55	0.65	0.37	0.75	1.50	1.26	1.46	1.87	2.09	21.85
						3.89			2.19			6.18			2.29			5.38			5.06	
6	Ill., Morris to mouth of DesPlaines: Kankakee, mouth to Custer Park	1,135	4	0.12	2.06	1.71	0.18	1.89	0.12	0.96	2.52	2.70	0.24	1.20	0.85	1.21	2.58	1.59	1.67	1.27	2.12	24.99
						3.30			2.06			4.55			1.70			4.45			3.92	
7	Illinois above Morris	7,575	27	0.21	1.80	1.29	0.36	1.48	0.22	0.32	2.39	1.84	0.29	0.70	0.71	0.83	2.28	1.34	1.20	1.13	1.59	19.98
						2.63			1.89			3.71			2.06			2.70			3.97	
8	Fox above Algonquin	1,335	5	0.01	1.32	1.30	0.47	1.23	0.19	0.12	2.50	1.09	0.38	1.22	0.46	0.53	1.42	0.75	0.46	0.87	2.64	16.96
						3.35			2.26			4.22			1.94			3.69			4.36	
9	Fox above Wedron	2,530	8	0.03	0.99	2.33	0.47	1.63	0.16	0.30	2.64	1.28	0.46	1.01	0.47	0.68	1.90	1.11	1.18	0.80	2.38	19.82
						4.07			1.96			5.91			2.61			6.23			3.05	
10	Vermilion above Streator	1,055	4	0.42	2.01	1.64	0.11	1.75	0.10	0.64	2.41	2.86	0.16	1.26	1.19	1.32	3.23	1.68	1.38	0.32	1.35	23.83

11	Vermilion above mouth	1,280	5	0.37	2.08	1.58	4.03	0.11	1.69	0.09	1.89	0.66	2.58	2.83	6.07	0.17	1.22	1.29	2.68	1.30	3.32	1.61	6.23	1.43	0.28	1.46	3.17	24.07
12	Illinois, Morris to LaSalle	570	2	0.07	2.61	2.18	4.16	0.53	1.65	0.10	2.28	1.29	2.41	1.82	5.32	0.25	1.65	1.19	3.09	0.83	4.65	1.04	6.52	1.48	0.61	3.20	5.29	27.56
13	Illinois above LaSalle	11,955	42	0.18	1.98	1.52	3.66	0.40	1.55	0.17	2.12	0.52	2.43	1.84	4.79	0.32	0.96	0.80	2.08	0.84	2.80	1.26	4.90	1.30	0.93	2.00	4.23	21.78
14	Illinois, LaSalle to Peoria	1,610	6	0.16	2.11	1.69	3.96	0.25	1.88	0.08	2.21	0.42	2.76	2.49	5.67	0.39	1.69	1.01	3.09	0.94	3.54	1.97	6.45	1.49	0.55	1.22	3.26	24.64
15	Illinois above Peoria	13,565	48	0.16	2.00	1.53	3.69	0.38	1.56	0.17	2.11	0.50	2.51	1.91	4.92	0.34	1.03	0.85	2.22	0.86	2.90	1.33	5.09	1.17	1.07	1.97	4.21	22.24
16	Illinois, Peoria to Havana	1,050	4	0.63	2.07	1.73	4.43	0.32	1.85	0.12	2.29	0.26	2.60	2.87	5.73	0.51	1.08	1.26	2.85	1.12	3.52	1.52	6.16	1.74	0.58	1.47	3.79	25.25
17	Mackinaw above Green Valley	1,120	4	0.76	2.04	1.71	4.51	0.20	1.68	0.14	2.02	0.64	2.11	3.01	5.76	0.44	1.06	1.03	2.53	1.30	4.46	3.02	8.78	1.88	0.43	0.84	3.15	26.75
18	Spoon above Seville	1,580	6	0.03	1.98	2.07	4.08	0.26	1.43	0.03	1.72	0.71	2.55	2.39	5.65	0.30	2.05	0.91	3.26	1.42	4.21	2.18	7.81	2.80	1.17	2.35	6.32	28.84
19	Spoon above mouth	1,800	6	0.07	2.01	2.03	4.11	0.26	1.46	0.03	1.75	0.65	2.50	2.44	5.59	0.32	1.93	0.98	3.23	1.44	4.20	2.14	7.78	2.72	1.15	2.26	6.13	28.59
20	Illinois above Havana	17,535	62	0.23	1.99	1.61	3.83	0.37	1.58	0.15	2.10	0.50	2.49	2.09	5.08	0.36	1.12	0.90	2.38	0.95	3.15	1.54	5.64	1.42	1.00	1.88	4.30	23.33
21	Illinois, Havana to Beardstown	485	2	0.50	2.32	1.64	4.46	0.13	1.86	0.06	2.05	0.20	2.00	2.87	5.07	0.41	0.99	1.52	2.92	1.71	4.05	1.78	7.54	2.07	0.99	1.56	4.62	26.66
22	Sangamon above Riverton	2,710	10	0.80	2.49	1.39	4.68	0.17	2.16	0.10	2.43	0.44	2.20	5.52	8.16	0.59	0.84	1.59	3.02	0.92	3.12	2.48	6.52	1.64	1.05	0.80	3.49	28.30

TABLE NO. A-8—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—January, 1898-June, 1898.																		
		Square miles.	Per cent.	January.			February.			March.			April.			May.			June.			Total.
						4.66			2.30			7.80			2.91			6.65			3.81	
23	Sangamon above mouth	5,465	19	0.84	2.40	1.42	0.11	2.10	0.09	0.38	2.01	5.41	0.55	0.88	1.48	1.00	3.18	2.47	2.02	0.94	0.85	28.13
						4.03			2.14			5.71			2.52			5.92			4.19	
24	Illinois above Beardstown	23,485	83	0.38	2.12	1.53	0.31	1.71	0.12	0.46	2.38	2.87	0.42	1.08	1.02	0.98	3.20	1.74	1.58	0.96	1.64	24.51
						4.74			2.56			5.80			4.23			7.68			5.06	
25	Illinois, Beardstown to Pearl	1,620	6	0.96	2.01	1.77	0.11	2.20	0.35	0.25	2.43	3.02	1.00	1.88	1.35	2.13	3.71	1.84	2.38	1.51	1.17	30.07
						3.41			1.72			5.88			4.17			8.08			3.38	
26	Crooked Creek above Ripley	1,265	4	0.23	1.79	1.39	0.29	1.39	0.04	0.88	2.37	2.63	0.65	1.98	1.54	1.49	5.62	0.97	1.92	0.77	0.69	26.64
						4.05			2.25			5.72			2.71			6.14			4.21	
27	Illinois above Pearl	26,370	83	0.41	2.08	1.56	0.34	1.77	0.14	0.46	2.40	2.86	0.46	1.17	1.08	1.08	3.36	1.70	1.66	0.98	1.57	25.08
						5.03			2.00			6.58			4.23			7.56			3.40	
28	Illinois, Pearl to Grafton	900	4	1.16	2.53	1.34	0.07	1.71	0.22	0.23	2.31	4.04	0.74	1.55	1.94	1.97	2.63	2.96	0.92	1.56	0.92	28.80
						5.01			1.98			7.17			4.37			7.62			3.49	
29	Macoupin Creek above Kane	875	3	0.92	2.43	1.66	0.04	1.81	0.13	0.02	2.49	4.66	0.89	1.09	2.39	1.83	2.82	2.97	0.94	1.62	0.93	29.64
						4.12			2.24			5.80			2.80			6.22			4.15	
30	Illinois above Grafton	28,145	100	0.44	2.11	1.57	0.33	1.77	0.14	0.44	2.39	2.97	0.48	1.17	1.15	1.11	4.24	0.87	1.61	1.00	1.54	25.33

TABLE NO. A-9—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—January, 1893-July, 1893.																					
		Square miles.	Per cent.	January.			February.			March.			April.			May.			June.			July.			Total.
						1.87			6.27			2.90			7.10			5.13			1.38			0.78	
1	Iroquois at Chebanse	2,185	8	0.68	0.68	0.51	3.04	1.81	1.42	1.04	0.70	1.16	0.91	3.72	2.47	0.82	1.34	2.97	1.11	0.22	0.05	0.20	0.46	0.12	25.43
						3.12			1.78			3.21			5.54			4.01			2.25			1.15	
2	Kankakee above Momence	2,395	9	0.45	1.43	1.24	0.65	0.83	0.30	1.11	0.80	1.30	0.38	2.34	2.82	0.47	1.42	2.12	1.95	0.15	0.15	0.67	0.48	0.00	21.06
						2.76			4.64			2.34			6.75			4.31			1.68			1.15	
3	Kankakee above Custer Park	5,010	18	0.62	0.88	1.26	2.18	1.36	1.10	0.87	0.66	0.81	0.67	3.53	2.55	0.72	1.05	2.54	1.45	0.18	0.05	0.67	0.48	0.00	23.63
						1.91			2.18			2.14			5.69			2.15			4.33			3.26	
4	DesPlaines above Joliet	835	3	0.23	0.44	1.24	1.16	0.88	0.14	0.96	0.44	0.74	0.33	2.56	2.80	0.41	0.58	1.16	2.84	1.10	0.39	2.10	0.97	0.19	21.66
						1.88			2.04			2.22			5.46			2.16			4.03			2.62	
5	DesPlaines above mouth	1,430	5	0.27	0.50	1.11	1.03	0.81	0.20	1.02	0.52	0.68	0.22	2.31	2.93	0.43	0.55	1.18	2.44	1.27	0.32	1.67	0.78	0.17	20.41
						2.24			3.20			2.76			5.84			3.00			1.87			1.09	
6	Ill., Morris to mouth of DesPlaines; Kankakee, mouth to Custer Park	1,135	4	0.51	0.73	1.00	1.48	1.17	0.55	1.08	0.71	0.97	0.84	1.66	3.34	0.47	0.95	1.58	1.16	0.66	0.05	0.89	0.12	0.08	20.00
						2.37			3.51			2.82			6.07			3.84			2.25			1.32	
7	Illinois above Morris	7,575	27	0.50	0.88	0.99	1.63	1.20	0.68	1.07	0.69	1.06	0.57	2.69	2.81	0.59	1.12	2.13	1.67	0.47	0.11	0.77	0.48	0.07	22.18
						1.47			1.03			2.40			5.12			2.05			4.61			3.26	
8	Fox above Algonquin	1,335	5	0.19	0.35	0.93	0.52	0.14	0.37	1.10	0.49	0.81	0.86	2.66	1.60	0.43	0.82	0.80	2.86	1.59	0.16	2.45	0.50	0.31	19.94
						1.57			1.65			2.54			4.94			2.16			4.09			2.55	
9	Fox above Wedron	2,530	8	0.24	0.46	0.87	0.78	0.50	0.37	1.13	0.54	0.87	0.51	2.50	1.93	0.53	0.87	0.76	2.42	1.53	0.14	1.90	0.38	0.27	19.50
						1.74			4.04			3.00			6.68			3.95			1.06			0.86	
10	Vermilion above Streator	1,055	5	0.55	0.56	0.63	1.97	1.43	0.64	1.33	0.60	1.07	1.35	1.87	3.46	0.60	1.11	2.24	0.78	0.27	0.01	0.42	0.19	0.25	21.33

TABLE NO. A-9—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—January, 1893-July, 1893.																					
		Square miles.	Per cent.	January.			February.			March.			April.			May.			June.			July.			Total.
						1.84			3.81			3.10			6.54			3.43			1.04			0.89	
11	Vermilion above mouth	1,280	5	0.56	0.59	0.69	1.84	1.41	0.56	1.30	0.65	1.15	1.40	1.67	3.47	0.33	1.24	1.86	0.77	0.26	0.01	0.53	0.16	0.20	20.65
						2.20			3.03			3.30			5.34			2.08			2.32			1.02	
12	Illinois, Morris to LaSalle	570	2	0.53	0.66	1.01	1.44	1.37	0.22	1.16	0.77	1.37	0.24	3.26	1.84	0.59	1.09	0.40	1.16	0.90	0.26	0.97	0.05	0.00	19.29
						2.13			3.14			2.83			5.84			3.36			2.50			1.53	
13	Illinois above LaSalle	11,955	42	0.45	0.73	0.95	1.47	1.09	0.58	1.12	0.66	1.05	0.96	2.24	2.64	0.55	1.08	1.73	1.70	0.68	0.12	0.99	0.41	0.13	21.33
						1.66			2.99			3.23			6.22			2.64			3.26			1.13	
14	Illinois, LaSalle to Peoria	1,610	6	0.36	0.55	0.75	1.43	1.06	0.50	1.53	0.57	1.13	0.47	3.14	2.61	0.53	0.84	1.27	2.03	1.04	0.19	0.72	0.11	0.30	21.13
						2.07			3.12			2.89			5.90			3.26			2.58			1.49	
15	Illinois above Peoria	13,565	48	0.43	0.70	0.94	1.47	1.08	0.57	1.19	0.66	1.05	0.91	2.34	2.65	0.54	1.06	1.66	1.73	0.72	0.13	0.97	0.38	0.13	21.31
						1.24			4.16			3.23			8.31			4.51			3.52			2.37	
16	Illinois, Peoria to Havana	1,050	4	0.24	0.45	0.55	2.07	1.36	0.73	2.05	0.18	1.00	0.38	4.19	3.74	0.48	1.20	2.83	1.13	2.14	0.25	0.88	0.29	1.20	27.34
						1.40			3.62			3.16			8.33			4.83			1.98			1.25	
17	Mackinaw above Green Valley	1,120	4	0.41	0.46	0.53	1.85	1.20	0.57	1.87	0.37	0.92	0.24	4.40	3.69	0.35	1.75	2.73	0.68	1.22	0.08	0.28	0.34	0.63	24.57
						1.36			1.76			2.61			6.34			3.36			1.85			1.88	
18	Spoon above Seville	1,580	6	0.63	0.30	0.43	0.65	0.94	0.17	1.29	0.46	0.86	0.16	4.00	2.18	0.68	0.58	2.10	0.46	1.02	0.37	1.35	0.14	0.39	19.16
						1.34			1.88			2.61			6.49			3.55			1.90			2.07	
19	Spoon above mouth	1,800	6	0.61	0.31	0.52	0.71	1.01	0.16	1.31	0.44	0.86	0.20	4.04	2.25	0.68	0.63	2.14	0.54	0.96	0.40	1.41	0.16	0.50	19.84
						1.91			3.15			2.92			6.27			3.47			2.53			1.58	
20	Illinois above Havana	17,535	62	0.44	0.63	0.84	1.48	1.11	0.56	1.28	0.60	1.04	0.78	2.74	2.75	0.55	1.06	1.86	1.52	0.85	0.16	0.94	0.36	0.28	21.83

						1.04			2.76			3.42			8.55			6.49			2.58			3.05	
21	Illinois, Havana to Beardstown	485	2	0.23	0.33	0.48	1.40	1.20	0.16	2.05	0.30	1.07	0.92	4.64	2.99	0.70	1.01	4.78	1.22	0.65	0.71	1.74	0.32	0.99	27.89
						0.89			2.67			3.68			10.88			4.63			2.06			1.58	
22	Sangamon above Riverton	2,710	10	0.26	0.46	0.17	1.55	0.83	0.29	1.58	0.56	1.54	2.76	4.22	3.90	0.28	1.17	3.18	1.35	0.47	0.24	0.66	0.08	0.84	26.39
						0.94			2.81			3.50			9.90			5.26			1.78			1.74	
23	Sangamon above mouth	5,465	19	0.26	0.43	0.25	1.49	1.04	0.28	1.08	1.07	1.35	1.74	4.51	3.65	0.35	1.37	3.54	1.06	0.50	0.22	0.76	0.19	0.79	25.93
						1.67			3.06			3.08			7.12			3.92			2.35			1.64	
24	Illinois above Beardstown	23,485	83	0.40	0.57	0.70	1.49	1.08	0.49	1.40	0.56	1.12	1.00	3.15	2.97	0.50	1.13	2.29	1.39	0.77	0.19	0.91	0.31	0.42	22.84
						0.63			2.64			5.08			8.66			8.31			3.77			2.83	
25	Illinois, Beardstown to Pearl	1,620	6	0.14	0.21	0.28	1.17	1.27	0.20	3.06	0.16	1.86	1.36	3.03	4.27	0.92	3.13	4.26	1.16	0.58	2.03	1.56	0.47	0.80	31.92
						1.58			1.87			2.89			7.83			5.71			2.55			2.53	
26	Crooked Creek above Ripley	1,265	4	0.87	0.26	0.45	0.82	0.97	0.08	1.57	0.27	1.05	0.55	4.02	3.26	0.69	1.02	4.00	1.12	0.56	0.87	1.71	0.24	0.58	24.96
						1.60			2.97			3.14			7.26			4.27			2.46			1.75	
27	Illinois above Pearl	26,370	93	0.41	0.52	0.67	1.44	1.08	0.45	1.50	0.50	1.14	1.03	3.18	3.05	0.54	1.24	2.49	1.34	0.76	0.36	0.97	0.32	0.46	23.45
						0.49			2.32			4.63			9.35			4.59			4.91			1.78	
28	Illinois, Pearl to Grafton	900	4	0.12	0.20	0.17	1.35	0.77	0.25	2.00	0.24	2.39	1.78	3.48	4.09	0.60	0.42	3.57	1.30	1.22	2.39	0.91	0.20	0.67	28.12
						0.47			2.64			4.54			9.98			4.08			4.71			1.88	
29	Macoupin Creek near Kane	875	3	0.12	0.20	0.15	1.58	0.81	0.25	1.92	0.25	2.37	2.36	3.46	4.16	0.53	0.48	3.07	1.42	1.11	2.18	0.87	0.18	0.83	28.30
						1.52			2.94			3.25			7.39			4.27			2.62			1.76	
30	Illinois above Grafton	28,145	100	0.38	0.50	0.64	1.43	1.07	0.44	1.54	0.50	1.21	1.10	3.19	3.10	0.55	1.18	2.54	1.34	0.81	0.47	0.96	0.32	0.48	23.75

TABLE NO. A-10—WEIGHTED AVERAGE TEN-DAY PRECIPITATIONS ON ILLINOIS RIVER WATERSHED.

Ref. No.	Watershed.	Areas.		Flood period—March, 1892-August, 1892.																		
		Square miles.	Per cent.	March.			April.			May.			June.			July.			August.			Total.
						2.29			6.77			8.95			4.72			1.46			2.50	
1	Iroquois above Chebanse	2,185	8	0.64	0.01	1.64	3.55	1.60	1.62	3.87	2.34	2.74	0.23	1.96	2.53	0.58	0.38	0.50	1.63	0.28	0.59	26.69
						2.99			3.27			7.81			9.86			2.31			2.05	
2	Kankakee above Momence	2,395	9	0.73	0.13	2.13	1.51	0.90	0.86	4.38	1.39	2.04	1.20	3.88	4.78	1.53	0.20	0.58	1.02	0.65	0.38	28.29
						2.61			5.09			8.41			7.16			1.86			2.26	
3	Kankakee above Custer Park	5,010	18	0.67	0.05	1.89	2.58	1.26	1.25	4.11	1.91	2.39	0.70	2.87	3.59	1.04	0.28	0.54	1.32	0.45	0.49	27.39
						1.61			3.16			7.25			11.39			2.70			1.57	
4	Desplaines above Joliet	835	3	0.37	0.03	1.21	1.23	1.14	0.79	3.85	1.47	1.93	2.56	4.15	4.68	1.56	0.26	0.88	0.44	0.14	0.99	27.68
						1.86			3.21			7.63			11.89			3.42			2.04	
5	Desplaines above mouth	1,430	5	0.41	0.03	1.42	1.30	1.04	0.87	4.01	1.74	1.88	2.31	4.35	5.23	1.97	0.48	0.97	0.88	0.17	0.99	30.05
						2.57			4.26			10.38			10.06			3.99			1.93	
6	Ill., Morris, to mouth of DesPlaines; Kankakee, mouth to Custer Park	1,135	4	0.67	0.17	1.73	2.02	0.99	1.25	5.75	2.55	2.08	1.63	4.31	4.12	2.49	0.84	0.66	1.10	0.15	0.68	33.19
						2.47			4.61			8.54			8.53			2.47			2.18	
7	Illinois above Morris	7,575	27	0.64	0.07	1.76	2.25	1.19	1.17	4.33	1.98	2.23	1.15	3.38	4.00	1.43	0.41	0.63	1.21	0.35	0.62	28.80
						1.37			3.22			7.68			8.06			2.71			3.01	
8	Fox above Algonquin	1,335	5	0.34	0.03	1.00	1.28	0.38	1.56	4.16	1.58	1.94	2.69	2.85	2.52	1.00	0.35	1.36	0.85	0.02	2.14	26.05
						1.83			2.47			9.04			9.74			3.38			2.75	
9	Fox above Wedron	2,530	8	0.48	0.09	1.26	1.53	0.58	1.36	4.88	2.04	2.12	2.30	3.74	3.70	1.73	0.57	1.08	1.06	0.06	1.63	29.21
						2.17			5.86			9.94			6.96			3.76			1.42	
10	Vermilion above Streator	1,055	5	0.57	0.16	1.44	3.01	1.16	1.69	5.03	2.66	2.25	1.26	3.57	2.13	1.36	1.50	0.90	1.04	0.07	0.31	30.11

						2.35			5.40			10.62			7.70			4.02			1.27	
11	Vermilion above mouth	1,280	5	0.63	0.21	1.51	2.74	1.06	1.60	5.72	2.69	2.21	1.40	3.95	2.35	1.77	1.46	0.79	0.88	0.06	0.33	31.36
						3.05			3.56			13.25			10.56			4.92			0.81	
12	Illinois, Morris to LaSalle	570	2	0.83	0.44	1.78	1.66	0.73	1.17	8.45	2.88	1.92	1.97	5.43	3.16	3.48	1.15	0.29	0.44	0.00	0.37	36.15
						2.35			4.42			9.12			8.83			2.97			2.12	
13	Illinois above LaSalle	11,955	42	0.60	0.10	1.65	2.14	1.02	1.26	4.81	2.16	2.15	1.48	3.62	3.73	1.64	0.59	0.74	1.09	0.24	0.79	29.81
						2.50			4.87			9.78			7.35			4.60			1.12	
14	Illinois, LaSalle to Peoria	1,610	6	0.68	0.12	1.70	2.21	1.51	1.15	5.29	2.55	1.94	0.97	3.83	2.55	2.65	1.05	0.90	0.48	0.07	0.57	30.22
						2.37			4.48			9.21			8.66			3.15			2.00	
15	Illinois above Peoria	13,565	48	0.60	0.10	1.67	2.15	1.07	1.26	4.87	2.20	2.14	1.44	3.64	3.58	1.78	0.66	0.71	1.02	0.23	0.75	29.87
						1.70			6.14			8.00			4.58			3.01			1.54	
16	Illinois, Peoria to Havana	1,050	4	0.53	0.01	1.16	3.25	2.57	0.32	4.04	2.17	1.79	0.13	3.53	0.92	0.92	1.08	1.01	0.92	0.21	0.41	24.97
						1.58			6.57			8.35			6.18			4.24			1.32	
17	Mackinaw above Green Valley	1,120	4	0.45	0.04	1.09	3.52	1.64	1.41	3.93	2.41	2.01	1.05	3.75	1.38	0.68	2.14	1.42	1.01	0.07	0.24	28.24
						1.70			6.04			7.92			4.43			2.97			1.54	
18	Spoon above Seville	1,580	6	0.51	0.01	1.18	3.16	2.54	0.34	4.01	2.17	1.74	0.14	3.41	0.88	0.92	1.04	1.01	0.92	0.21	0.41	24.60
						1.60			5.89			7.79			4.28			2.89			1.54	
19	Spoon above mouth	1,800	6	0.45	0.01	1.14	3.03	2.49	0.37	3.91	2.18	1.70	0.14	3.36	0.78	0.90	0.98	1.01	0.92	0.21	0.41	23.99
						2.20			4.84			8.93			7.81			3.18			1.89	
20	Illinois above Havana	17,535	62	0.55	0.08	1.57	2.35	1.33	1.16	4.68	2.19	2.06	1.21	3.60	3.00	1.57	0.78	0.83	1.01	0.22	0.66	28.85
						2.12			6.60			7.37			2.76			4.55			0.60	
21	Illinois, Havana to Beardstown	485	2	0.53	0.20	1.39	3.48	2.56	0.56	3.49	2.17	1.71	0.55	1.99	0.22	1.24	1.75	1.56	0.13	0.00	0.47	24.00
						2.62			7.21			8.28			3.14			4.50			2.96	
22	Sangamon above Riverton	2,710	10	0.97	0.06	1.59	3.91	1.97	1.33	2.30	3.50	2.48	0.70	1.99	0.45	3.16	1.13	0.21	2.48	0.05	0.43	28.71

TABLE NO. A-10—Concluded.

Ref. No.	Watershed.	Areas.		Flood period—March, 1892-August, 1892.																		
		Square miles.	Per cent.	March.			April.			May.			June.			July.			August.			Total.
						2.29			6.64			7.85			3.75			4.39			2.29	
23	Sangamon above mouth	5,465	19	0.76	0.07	1.46	3.42	1.87	1.35	2.82	2.98	2.05	0.87	2.31	0.57	2.44	1.40	0.55	1.62	0.05	0.62	27.21
						2.21			5.30			8.66			6.78			3.50			1.95	
24	Illinois above Beardstown	23,485	83	0.61	0.07	1.53	2.64	1.49	1.17	4.23	2.36	2.07	1.13	3.27	2.38	1.77	0.96	0.77	1.13	0.18	0.64	28.40
						2.55			7.04			8.52			2.23			5.95			0.87	
25	Illinois, Beardstown to Pearl	1,620	6	0.74	0.08	1.73	3.22	3.08	0.74	3.70	2.43	2.39	0.66	0.76	0.81	2.63	1.95	1.37	0.36	0.17	0.34	27.16
						2.60			7.14			6.97			2.63			5.91			0.75	
26	Crooked Creek above Ripley	1,265	4	0.64	0.24	1.72	3.94	2.76	0.44	3.44	1.79	1.74	0.89	1.49	0.25	1.49	2.09	2.33	0.26	0.07	0.42	26.00
						2.25			5.50			8.56			6.28			3.77			1.81	
27	Illinois above Pearl	26,370	93	0.63	0.08	1.54	2.76	1.64	1.10	4.16	2.33	2.07	1.09	3.02	2.17	1.81	1.07	0.89	1.03	0.17	0.61	28.17
						2.32			6.45			9.13			2.65			6.13			0.98	
28	Illinois, Pearl to Grafton	900	4	0.90	0.01	1.41	2.51	3.20	0.74	3.46	2.57	3.10	0.71	1.33	0.61	3.43	1.76	0.94	0.80	0.06	0.12	27.66
						2.37			6.67			8.68			2.93			5.65			1.31	
29	Macoupin Creek above Kane	875	3	0.92	0.04	1.41	2.80	3.15	0.72	3.15	2.80	2.73	0.81	1.61	0.51	3.36	1.52	0.77	0.63	0.14	0.54	27.61
						2.26			5.55			8.55			6.17			3.83			1.79	
30	Illinois above Grafton	28,145	100	0.62	0.08	1.56	2.77	1.68	1.10	4.12	2.33	2.10	1.07	2.98	2.12	1.86	1.08	0.89	1.01	0.16	0.62	28.15

TABLE NO. A-11.

TOTAL MONTHLY PRECIPITATION, COMBINED NORTHERN AND CENTRAL DISTRICTS, ILLINOIS—AVERAGE OF ALL STATIONS.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Normal	1.95	2.03	2.84	3.30	4.02	3.99	3.59	3.21	3.69	2.58	2.35	2.08	35.57
1856	1.33	2.71	0.55	1.86	3.80	2.51	3.18	2.31	2.60	2.88	3.65	4.72	32.10
1857	0.62	4.80	2.87	1.21	2.64	3.34	2.14	4.62	1.74	2.25	2.57	1.28	30.05
1858	1.92	1.91	2.63	4.83	7.96	5.72	6.01	2.56	3.40	3.71	3.39	2.73	46.72
1859	2.16	2.20	4.98	3.34	6.14	4.20	1.55	3.75	2.90	1.76	2.44	1.08	36.49
1860	------	------	------	------	------	------	------	------	------	------	------	------	------
1861	1.34	2.51	4.08	3.79	3.22	4.16	2.59	2.06	4.26	2.86	0.93	1.40	33.18
1862	4.70	0.75	2.66	5.88	2.39	4.67	6.38	4.44	6.11	1.66	2.15	4.17	45.94
1863	2.85	3.53	2.78	------	2.86	0.52	2.98	2.30	2.74	3.91	1.07	3.73	29.27
1864	2.02	0.80	2.42	4.86	1.96	2.00	3.37	1.71	3.15	2.31	3.43	3.17	31.17
1865	0.55	3.72	3.72	5.39	1.35	5.22	7.67	3.63	6.54	2.78	0.22	1.05	41.81
1866	3.13	2.00	2.27	3.21	2.84	1.81	4.09	3.84	7.45	3.49	0.52	2.50	37.14
1867	1.50	3.57	1.76	1.55	5.41	3.26	2.89	2.48	1.29	1.10	1.74	1.19	27.71
1868	1.08	0.68	5.89	4.87	6.51	2.39	2.74	3.39	4.21	1.45	3.79	1.79	38.71
1869	2.18	2.25	1.46	4.10	5.24	6.80	6.97	5.11	1.23	1.55	3.68	2.47	43.01
1870	2.78	0.96	5.29	1.12	1.53	1.69	2.50	3.99	3.68	3.97	1.56	1.52	30.56
1871	3.64	1.81	3.27	2.35	2.36	3.66	2.63	3.29	0.61	3.30	2.61	2.35	31.85
1872	0.42	0.97	2.51	3.12	3.26	6.38	4.91	4.30	4.11	0.67	1.28	1.09	32.99
1873	3.76	1.22	1.00	5.57	4.92	1.78	4.39	1.20	3.11	2.63	1.65	4.93	36.15
1874	3.12	1.47	1.52	2.82	2.53	3.71	2.50	4.45	4.41	1.53	2.48	0.85	31.38
1875	0.47	1.83	2.12	2.00	4.61	5.46	9.94	1.96	5.56	2.57	0.64	3.05	40.19
1876	2.45	2.07	4.16	3.52	4.40	5.32	5.74	3.90	6.91	2.02	2.52	0.33	43.31
1877	1.02	0.10	4.04	3.18	3.26	7.59	4.17	2.54	2.34	6.69	3.73	3.29	41.92
1878	0.72	2.47	3.32	3.65	4.63	3.42	2.97	5.35	1.30	3.24	1.14	2.41	34.59
1879	0.69	0.87	1.82	1.78	2.42	3.25	2.99	3.41	1.59	1.36	4.32	1.80	26.21
1880	3.68	3.11	2.91	4.83	5.82	3.39	2.91	3.92	2.91	1.92	1.56	1.27	38.19
1881	0.95	4.93	3.51	1.96	2.15	7.12	3.08	1.37	4.62	7.60	4.94	3.05	45.28
1882	1.61	3.38	3.78	4.14	6.35	8.56	3.32	3.72	1.29	3.45	2.14	2.08	43.78
1883	1.56	5.71	0.95	3.78	5.55	5.05	4.31	1.29	1.40	6.48	4.30	1.73	42.09
1884	1.15	3.17	3.00	2.60	3.53	4.07	4.24	2.76	4.67	4.09	1.87	4.30	39.40
1885	2.74	1.38	0.33	4.33	2.76	5.31	3.09	5.95	4.77	4.16	1.54	2.75	39.08
1886	2.85	1.62	2.83	2.68	4.27	3.54	1.08	3.51	5.29	1.39	1.75	1.17	31.96
1887	1.78	4.61	1.68	2.03	2.90	1.47	2.12	2.99	3.50	1.78	2.87	3.97	31.63
1888	2.15	1.84	3.20	1.86	6.47	4.18	4.54	3.06	1.67	2.78	3.59	2.45	37.77
1889	1.84	1.50	1.52	2.15	5.19	4.99	5.03	0.91	3.70	2.11	3.08	1.71	33.70
1890	3.91	1.94	2.51	2.63	3.81	5.12	1.98	2.37	2.41	2.93	1.82	0.60	32.02
1891	1.76	2.21	2.85	3.50	2.09	3.63	2.64	4.83	0.94	1.21	4.51	1.63	31.76
1892	1.66	2.19	2.33	5.84	8.80	6.72	3.96	1.97	2.30	0.96	3.11	1.80	41.61
1893	1.26	3.31	3.17	6.39	3.98	2.84	2.03	0.57	2.90	0.88	2.20	1.62	31.11
1894	2.14	1.90	2.81	2.33	2.91	2.56	1.15	1.65	5.18	1.17	1.91	1.58	27.27
1895	1.40	0.58	1.19	2.02	2.05	2.27	5.47	2.90	3.15	0.67	3.53	5.35	30.54
1896	1.07	1.82	1.39	2.96	5.03	3.66	5.20	3.30	5.88	0.98	2.18	0.45	33.89
1897	4.98	1.49	4.43	3.68	1.83	4.64	3.34	1.13	1.07	0.32	3.83	1.97	32.68
1898	4.13	2.09	6.35	3.00	5.99	4.08	1.96	4.58	5.09	3.85	2.31	1.30	44.69
1899	1.03	1.87	2.73	1.36	6.71	2.46	3.39	2.73	2.38	3.17	1.73	2.09	31.62
1900	1.31	4.17	2.13	1.41	4.01	2.71	4.16	4.92	3.54	2.67	2.59	0.55	34.15
1901	1.53	1.46	3.29	1.25	1.84	3.97	2.84	1.50	2.00	1.62	1.22	2.32	24.80
1902	0.76	1.38	3.49	2.48	4.15	9.74	6.10	5.17	4.56	2.56	2.88	2.52	45.76
1903	1.25	2.57	2.51	4.70	3.50	2.84	3.86	4.67	4.63	2.33	0.96	1.56	35.35
1904	2.72	1.20	5.18	3.69	3.43	2.62	4.89	4.09	4.88	0.61	0.17	1.61	35.06
1905	1.34	1.57	2.02	3.74	4.44	3.66	3.75	3.36	2.99	3.47	2.13	1.62	34.08
1906	2.67	2.10	3.30	2.19	3.00	3.11	2.53	3.72	4.68	1.51	3.14	2.52	34.44
1907	5.19	0.29	2.99	2.61	3.62	4.10	6.40	5.40	3.05	1.17	1.79	2.14	38.73
1908	1.18	3.75	2.84	3.99	8.33	3.01	3.12	2.60	1.35	0.70	2.52	1.15	34.51
1909	1.94	3.64	1.68	6.12	3.98	4.23	4.42	2.41	3.38	2.75	4.20	2.95	41.66
1910	1.98	1.33	0.32	3.30	5.47	1.99	2.88	2.70	4.29	1.82	1.14	1.19	28.39
1911	2.03	2.21	1.76	3.98	2.06	2.59	2.86	3.84	9.43	2.86	2.91	2.01	38.46
1912	0.72	1.38	2.78	4.56	4.34	2.70	3.48	3.43	2.55	3.76	1.90	0.81	32.39
1913	2.78	1.81	4.48	2.73	3.57	2.85	1.44	2.48	2.58	3.22	2.59	0.89	31.39
1914	1.69	1.61	1.84	2.00	2.79	2.92	1.45	2.80	4.07	2.56	0.53	2.01	26.23
1915	1.95	2.13	0.80	1.56	6.65	4.27	7.50	4.89	5.04	0.74	2.25	1.83	39.57

TABLE NO. A-11—Continued.

TOTAL MONTHLY PRECIPITATION, COMBINED NORTHERN AND CENTRAL DISTRICTS, ILLINOIS—AVERAGE FOR ALL STATIONS—Concluded.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1916	5.96	0.69	2.10	1.57	5.12	5.29	0.84	3.33	2.85	3.21	1.96	1.87	34.77
1917	1.34	0.43	2.73	3.92	3.95	6.06	2.70	2.30	3.01	3.03	0.25	0.72	30.36
1918	2.10	1.78	0.93	4.42	4.88	3.67	2.91	3.59	3.26	3.24	2.21	2.76	35.73
1919	0.31	2.06	3.27	2.44	4.87	4.33	2.16	2.67	4.10	5.37	2.99	0.53	35.06
1920	0.99	0.46	4.86	4.90	3.95	2.37	2.08	2.28	2.49	1.97	1.11	2.38	29.83
1921	1.26	0.48	4.87	4.98	2.01	3.76	1.86	5.18	6.95	2.74	2.80	2.78	39.65
1922	1.31	1.23	5.42	4.67	3.91	1.10	4.00	1.59	2.26	1.75	2.99	1.56	31.74
1923	1.12	0.95	4.20	1.77	3.73	3.55	2.05	4.17	4.16	3.81	1.52	2.92	33.91
1924	1.61	1.57	2.70	2.07	2.84	7.31	3.17	6.29	3.09	1.16	1.10	3.25	36.12
1925	0.51	1.74	2.14	2.75	1.29	4.76	3.21	2.78	4.69	3.29	2.46	1.34	30.93
1926	1.36	2.43	2.33	2.95	2.60	5.20	4.13	4.23	10.63	3.27	3.89	1.10	44.10
1927	1.53	1.64	3.85	6.41	6.56	3.74	2.72	3.09	5.35	4.21	4.33	2.56	45.95

PRECIPITATION FOR NORTHERN DISTRICT—AVERAGE OF ALL STATIONS.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Normal	1.74	1.59	2.60	2.88	3.89	3.75	3.30	3.28	3.69	2.43	1.97	1.71	32.83
1856	1.35	0.73	0.20	1.54	5.12	1.81	2.77	1.47	1.57	2.26	3.82	5.48	28.12
1857	0.42	4.89	3.45	1.40	3.23	3.36	2.69	5.86	1.53	3.03	2.29	1.21	33.36
1858	1.77	2.15	2.88	5.33	8.61	5.86	5.42	3.15	3.84	3.71	3.61	2.88	49.21
1859	1.68	1.17	5.69	3.19	2.99	2.25	1.14	3.37	2.52	2.01	2.52	0.97	29.50
1860	2.26	1.87	0.83	1.80	2.92	3.54	5.95	1.62	2.30	0.55	3.58	3.98	31.20
1861	1.17	2.39	3.25	4.51	2.81	3.55	3.70	2.57	4.96	3.42	1.17	1.55	35.05
1862	4.51	0.81	3.08	4.89	2.78	5.00	7.41	7.18	6.07	1.69	2.10	3.40	48.92
1863	2.84	3.05	2.56	2.39	3.41	0.45	2.78	2.38	2.37	4.30	0.94	2.77	29.24
1864	1.69	0.87	2.68	4.16	1.82	2.72	3.09	1.84	3.00	2.18	3.08	3.58	30.71
1865	0.85	3.41	3.13	5.00	2.01	3.66	5.76	5.57	7.27	2.21	0.31	0.65	39.83
1866	2.63	1.27	2.10	1.95	2.13	2.14	4.58	4.58	6.21	2.07	0.53	2.54	32.73
1867	1.27	2.70	1.70	1.85	5.60	3.00	2.50	2.77	1.43	0.98	2.01	1.21	27.02
1868	1.09	0.86	5.56	4.25	6.60	2.13	1.91	3.09	4.32	1.31	3.51	1.17	35.80
1869	1.44	2.22	1.23	2.82	5.70	7.11	6.55	6.00	1.07	1.17	4.20	2.46	41.97
1870	3.52	1.44	6.17	0.74	1.36	1.04	1.88	3.23	4.36	4.26	1.27	1.13	30.40
1871	3.05	2.02	2.64	2.67	2.60	4.42	2.42	3.96	0.58	3.03	2.78	2.80	32.97
1872	0.32	0.52	2.14	3.61	3.73	5.14	4.14	6.39	5.30	0.78	1.41	0.88	34.36
1873	3.39	0.69	1.04	4.96	5.24	1.86	3.55	1.46	2.17	1.96	1.24	4.53	32.09
1874	3.29	1.17	1.37	2.75	2.84	3.61	1.66	3.65	4.90	1.67	2.42	0.61	29.94
1875	0.50	1.52	1.36	2.29	3.38	4.67	8.11	1.78	5.42	2.51	0.64	2.79	34.97
1876	2.76	2.65	3.74	3.36	4.10	5.18	4.36	2.78	4.23	2.01	2.77	0.44	38.38
1877	1.21	0.06	3.48	3.08	2.46	7.21	3.17	2.24	1.65	5.62	3.90	2.80	36.88
1878	0.58	1.66	2.68	4.50	5.07	3.43	2.82	5.02	1.34	3.89	0.73	1.93	33.65
1879	0.76	1.07	1.82	2.14	2.88	3.66	3.75	2.28	1.83	2.15	4.31	1.64	28.29
1880	3.48	2.89	2.73	4.71	5.62	4.04	3.70	4.75	3.03	1.95	1.38	1.04	39.32
1881	0.96	5.12	3.43	1.56	2.44	7.77	3.64	0.82	4.41	.6.76	3.96	2.76	43.63
1882	1.28	2.00	3.34	4.55	5.19	7.80	3.82	3.80	1.35	3.64	1.83	1.99	40.59
1883	1.81	4.71	0.62	4.09	6.57	4.56	4.48	1.14	1.90	5.78	5.04	1.68	42.38
1884	0.96	2.66	2.98	2.63	3.25	3.17	5.43	3.28	3.74	5.19	1.97	3.97	39.20
1885	2.58	1.54	0.35	3.68	2.37	4.28	3.32	7.68	4.45	3.95	1.56	3.09	38.85
1886	3.00	1.73	3.02	3.01	4.58	2.36	0.94	2.89	4.56	1.99	1.17	1.11	30.36
1887	2.37	4.90	1.00	1.14	1.79	1.49	2.57	3.37	3.35	2.62	1.75	3.96	30.25
1888	1.70	1.51	2.98	1.63	6.59	2.56	3.82	2.94	1.39	2.73	2.95	2.28	33.08
1889	1.78	1.22	1.60	2.93	4.77	4.28	6.15	0.97	3.33	1.58	2.58	1.78	32.97
1890	2.90	1.56	2.68	2.54	4.24	5.86	0.97	2.27	1.97	4.08	1.68	0.73	31.48
1891	2.09	1.73	2.50	3.61	2.27	3.98	2.95	4.49	1.06	1.04	4.12	1.92	31.76
1892	1.70	1.38	2.58	4.24	9.45	9.38	3.63	1.66	2.16	0.93	2.17	2.04	41.32
1893	1.62	3.16	2.73	5.35	3.01	3.13	2.04	0.50	2.93	1.08	2.40	1.84	29.79
1894	1.98	1.52	2.77	1.95	3.24	2.76	0.59	1.66	6.22	1.45	1.64	1.08	26.86
1895	1.49	0.44	0.97	1.56	2.36	1.65	5.74	3.18	2.86	0.87	3.60	4.90	29.62

TABLE A-11—Continued.

PRECIPITATION FOR NORTHERN DISTRICT—AVERAGE OF ALL STATIONS—Concluded.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1896	1.05	1.64	1.13	3.72	5.00	2.93	3.03	3.17	5.86	0.85	2.13	0.30	30.81
1897	4.94	1.45	3.96	2.93	1.29	4.30	2.87	1.08	1.52	0.31	3.24	1.40	29.29
1898	3.76	2.16	5.25	2.70	5.48	4.37	1.28	5.52	4.56	3.50	2.15	1.10	41.83
1899	0.53	1.64	2.31	1.29	5.55	2.48	3.99	2.09	2.36	2.79	1.32	1.97	28.32
1900	1.56	3.51	2.62	1.44	4.18	1.85	4.09	5.90	3.17	2.45	2.55	0.37	33.69
1901	1.35	1.39	3.28	0.73	1.82	3.13	3.88	1.32	2.46	1.06	1.15	1.60	23.17
1902	0.56	1.44	3.33	2.26	5.37	10.11	8.49	4.76	5.35	2.71	2.85	2.02	49.25
1903	1.11	2.14	2.72	4.67	3.90	2.56	4.57	5.08	5.82	2.25	0.85	1.40	37.07
1904	2.26	1.24	4.04	2.97	3.21	1.91	5.08	4.33	4.57	0.69	0.09	1.84	32.23
1905	0.92	1.60	2.37	3.93	5.01	4.35	2.82	3.58	2.45	2.64	2.05	1.39	33.11
1906	2.49	2.16	2.72	1.94	3.08	3.26	2.80	3.44	5.01	1.70	2.72	2.13	33.45
1907	4.48	0.25	2.43	2.44	3.80	3.42	6.41	5.29	4.55	0.82	1.65	1.70	37.24
1908	0.99	3.25	3.15	3.33	7.80	2.84	3.33	3.50	1.19	0.86	2.44	0.97	33.65
1909	1.75	3.21	1.61	6.24	3.16	4.07	2.83	3.25	3.06	2.25	4.42	3.58	39.43
1910	2.05	0.97	0.33	3.44	4.89	1.41	1.66	3.18	3.85	1.29	0.70	1.11	24.88
1911	1.62	2.39	1.46	3.62	2.50	3.03	2.83	4.41	8.35	2.80	3.14	2.01	38.16
1912	0.53	1.21	1.81	3.64	4.02	2.43	3.23	3.10	2.90	4.45	1.80	0.91	30.03
1913	1.58	2.05	3.51	2.43	5.42	2.90	1.68	3.05	1.95	3.03	1.73	0.83	30.16
1914	1.59	0.88	2.35	1.51	3.94	3.86	1.06	2.31	4.40	2.50	0.33	1.90	26.63
1915	1.76	2.17	0.76	1.00	6.21	2.95	7.95	3.65	5.22	0.69	2.38	0.97	35.71
1916	5.14	0.52	2.41	1.59	4.62	6.20	0.72	2.45	3.00	4.13	1.95	1.89	34.62
1917	1.28	0.38	1.92	3.36	3.13	5.19	2.75	1.48	3.26	3.58	0.21	0.70	27.23
1918	2.40	1.93	0.99	3.17	4.93	3.08	3.32	3.41	2.14	3.25	2.01	2.30	32.93
1919	0.29	2.19	3.60	3.22	4.64	3.20	2.53	2.15	4.57	4.94	2.84	0.69	34.86
1920	1.02	0.26	5.02	5.07	2.80	2.62	1.42	1.86	1.78	1.81	1.26	2.32	27.24
1921	0.81	0.39	4.62	5.12	1.97	3.64	1.49	5.23	7.22	3.10	2.39	3.12	39.10
1922	1.19	1.16	4.01	3.04	4.39	0.65	4.44	1.27	2.82	1.52	2.68	1.10	28.27
1923	0.85	0.86	3.85	1.28	3.22	3.80	1.72	3.58	3.75	3.73	1.36	2.20	30.20
1924	1.45	1.49	2.66	2.00	2.04	7.81	3.28	7.83	3.02	0.77	0.93	2.00	35.28
1925	0.52	2.01	1.27	3.03	1.33	4.91	3.22	1.69	5.22	3.12	2.02	1.32	29.65
1926	1.89	2.41	1.98	2.39	2.75	5.68	5.07	4.06	9.19	2.16	4.25	0.85	41.88
1927	1.13	1.83	2.63	6.22	5.59	3.40	1.68	2.54	5.88	4.21	3.84	2.18	41.13

PRECIPITATION FOR CENTRAL DISTRICT—AVERAGE OF ALL STATIONS.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Normal	2.14	1.89	3.16	3.46	4.07	3.94	3.34	3.40	3.65	2.48	2.34	2.15	36.02
1856	1.30	4.69	0.90	2.18	2.47	3.20	3.58	3.15	3.62	3.50	3.39	3.95	35.93
1857	0.82	4.70	2.29	1.02	2.05	3.31	1.58	3.37	1.94	1.46	2.85	1.34	26.73
1858	2.07	1.66	2.37	4.32	7.30	5.57	6.60	1.96	2.95	3.70	3.16	2.57	44.23
1859	2.64	3.22	4.27	3.49	9.29	6.14	1.96	4.12	3.28	1.51	2.36	1.19	43.47
1860	------	------	------	------	------	------	------	------	------	------	------	------	------
1861	1.51	2.62	4.91	3.07	3.63	4.76	1.48	1.55	3.55	2.29	0.68	1.25	31.30
1862	4.89	0.68	2.23	6.87	2.00	4.34	5.34	1.70	6.15	1.62	2.20	4.93	42.95
1863	2.85	4.01	2.99	------	2.31	0.58	3.18	2.22	3.11	3.52	1.19	4.68	------
1864	2.35	0.73	2.16	5.55	2.09	1.27	3.64	1.58	3.29	2.43	3.78	2.75	31.62
1865	0.25	4.02	4.30	5.77	0.69	6.77	9.58	1.69	5.81	3.34	0.12	1.44	43.78
1866	3.63	2.73	2.44	4.47	3.54	1.48	3.60	3.09	8.69	4.91	0.51	2.46	41.55
1867	1.73	4.44	1.82	1.24	5.22	3.51	3.27	2.18	1.14	1.21	1.47	1.16	28.39
1868	1.06	0.49	6.22	5.48	6.31	2.64	3.56	3.69	4.09	1.59	4.07	2.41	41.61
1869	2.92	2.27	1.69	5.37	4.78	6.48	7.38	4.22	1.38	1.93	3.16	2.47	44.05
1870	2.04	0.47	4.40	1.50	1.69	2.33	3.12	4.74	3.00	3.67	1.85	1.90	30.71
1871	4.22	1.60	3.89	2.02	2.11	2.90	2.83	2.62	0.63	3.57	2.43	1.90	30.72
1872	0.51	1.41	2.87	2.62	2.79	7.61	5.68	2.20	2.92	0.56	1.15	1.30	31.62
1873	4.13	1.75	0.96	6.18	4.59	1.71	5.22	0.94	4.05	3.30	2.05	5.33	40.21
1874	2.94	1.77	1.67	2.89	2.21	3.81	3.34	5.25	3.92	1.39	2.53	1.09	32.81
1875	0.43	2.13	2.88	1.70	5.84	6.25	11.77	2.14	5.70	2.62	0.64	3.30	45.40

TABLE NO. A-11—Concluded.

PRECIPITATION FOR CENTRAL DISTRICT—AVERAGE OF ALL SATTIONS—Concluded.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1876	2.13	1.48	4.57	3.68	4.70	5.46	7.12	5.02	9.58	2.02	2.27	0.21	48.24
1877	0.82	0.13	4.59	3.27	4.05	7.97	5.16	2.84	3.03	7.76	3.55	3.78	46.95
1878	0.86	3.27	3.96	2.79	4.19	3.41	3.11	5.67	1.25	2.58	1.55	2.89	35.53
1879	0.62	0.66	1.81	1.41	1.95	2.83	2.22	4.53	1.34	0.57	4.33	1.95	24.12
1880	3.88	3.32	3.09	4.94	6.01	2.73	2.11	3.08	2.78	1.89	1.74	1.49	37.06
1881	0.93	4.73	3.59	2.36	1.86	6.47	2.52	1.92	4.83	8.44	5.91	3.34	46.93
1882	1.94	4.76	4.21	3.72	7.50	9.31	2.81	3.64	1.22	3.25	2.45	2.16	46.97
1883	1.31	6.70	1.28	3.46	4.52	5.54	4.14	1.44	0.89	7.18	3.56	1.78	41.80
1884	1.34	3.67	3.02	2.56	3.81	4.97	3.04	2.23	5.59	2.99	1.76	4.62	39.60
1885	2.90	1.21	0.30	4.97	3.15	6.34	2.86	4.22	5.08	4.36	1.52	2.40	39.31
1886	2.70	1.51	2.64	2.34	3.96	4.71	1.22	4.13	6.02	0.78	2.32	1.22	33.55
1887	1.18	4.31	2.36	2.91	4.00	1.44	1.66	2.60	3.64	0.94	3.99	3.97	33.00
1888	2.60	2.17	3.41	2.09	6.35	5.79	5.26	3.18	1.95	2.83	4.22	2.61	42.45
1889	1.89	1.78	1.43	1.37	5.60	5.70	3.90	0.85	4.06	2.64	3.58	1.63	34.43
1890	4.91	2.32	2.34	2.72	3.38	4.38	2.99	2.46	2.85	1.77	1.96	0.47	32.55
1891	1.42	2.69	3.19	3.38	1.90	3.28	2.33	5.16	0.81	1.38	4.89	1.33	31.76
1892	1.62	3.00	2.07	7.43	8.15	4.06	4.29	2.27	2.43	0.99	4.04	1.55	41.90
1893	0.89	3.45	3.61	7.43	4.94	2.55	2.01	0.63	2.86	0.67	1.99	1.39	32.42
1894	2.30	2.27	2.85	2.71	2.58	2.35	1.71	1.64	4.13	0.88	2.18	2.07	27.67
1895	1.30	0.72	1.40	2.47	1.74	2.88	5.20	2.62	3.43	0.46	3.45	5.79	31.46
1896	1.08	2.00	1.65	2.19	5.05	4.39	7.36	3.43	5.89	1.10	2.23	0.59	36.96
1897	5.02	1.53	4.89	4.42	2.36	4.97	3.80	1.18	0.61	0.32	4.42	2.54	36.06
1898	4.49	2.01	7.45	3.29	6.50	3.79	2.63	3.63	5.62	4.19	2.46	1.49	47.55
1899	1.53	2.10	3.14	1.42	7.86	2.43	2.79	3.37	2.39	3.54	2.13	2.21	34.91
1900	1.05	4.83	1.64	1.37	3.84	3.57	4.22	3.94	3.90	2.89	2.63	0.73	34.61
1901	1.71	1.52	3.29	1.76	1.86	4.80	1.79	1.68	1.53	2.18	1.28	3.03	26.43
1902	0.96	1.31	3.65	2.69	2.92	9.36	3.71	5.58	3.76	2.41	2.90	3.02	42.27
1903	1.39	2.99	2.29	4.72	3.10	3.12	3.15	4.26	3.43	2.40	1.06	1.72	33.63
1904	3.18	1.15	6.31	4.41	3.62	3.33	4.69	3.85	5.19	0.52	0.25	1.38	37.88
1905	1.76	1.54	1.66	3.55	3.87	2.97	4.68	3.14	3.53	4.30	2.20	1.84	35.04
1906	2.84	2.04	3.88	2.43	2.91	2.96	2.25	3.99	4.35	1.32	3.55	2.90	35.42
1907	5.90	0.32	3.55	2.78	3.43	4.77	6.39	5.51	1.55	1.51	1.93	2.58	40.22
1908	1.36	4.24	2.53	4.65	8.86	3.17	2.89	1.70	1.50	0.54	2.60	1.32	35.36
1909	2.12	4.07	1.75	5.99	4.79	4.39	6.00	1.56	3.69	3.25	3.97	2.31	43.89
1910	1.90	1.69	0.31	3.15	6.04	2.57	4.10	2.22	4.72	2.34	1.58	1.27	31.89
1911	2.43	2.03	2.05	4.34	1.62	2.14	2.88	3.27	10.50	2.82	2.67	2.01	38.76
1912	0.90	1.55	3.74	5.48	4.66	2.96	3.73	3.76	2.20	3.06	2.00	0.70	34.74
1913	3.97	1.56	5.45	3.03	1.71	2.80	1.19	1.90	3.21	3.41	3.44	0.95	32.62
1914	1.78	2.33	1.32	2.49	1.63	1.98	1.83	3.28	3.73	2.62	0.72	2.12	25.83
1915	2.13	2.09	0.84	2.11	7.08	5.58	7.04	6.12	4.85	0.79	2.11	2.68	43.42
1916	6.78	0.85	1.78	1.55	5.63	4.37	0.96	4.20	2.70	2.29	1.96	1.85	34.92
1917	1.39	0.48	3.44	4.48	4.77	6.93	2.65	3.11	2.75	2.47	0.29	0.73	33.49
1918	1.80	1.62	0.86	5.66	4.82	4.26	2.50	3.77	4.38	3.23	2.41	3.22	38.53
1919	0.32	1.93	2.93	1.65	5.10	5.45	1.78	3.18	3.62	5.79	3.14	0.37	35.26
1920	0.96	0.66	4.70	4.72	5.10	2.11	2.74	2.69	3.19	2.13	0.95	2.47	32.42
1921	1.70	0.57	5.11	4.84	2.05	3.87	2.22	5.12	6.68	2.38	3.21	2.44	40.19
1922	1.42	1.29	6.82	6.29	3.42	1.54	3.55	1.88	1.70	1.98	3.30	2.01	35.20
1923	1.38	1.04	4.54	2.25	4.24	3.30	2.37	4.75	4.56	3.88	1.68	3.63	37.62
1924	1.76	1.64	2.74	2.13	3.64	6.80	3.05	4.75	3.15	1.54	1.27	4.49	36.96
1925	0.49	1.47	3.00	2.47	1.24	4.60	3.20	3.86	4.16	3.46	2.90	1.36	32.21
1926	1.63	2.44	2.67	3.50	2.45	4.72	3.18	4.40	12.07	4.37	3.53	1.35	46.31
1927	1.89	1.45	5.06	6.60	7.52	4.08	3.76	3.64	4.82	4.20	4.81	2.93	50.76

TABLE NO. A-12—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

IROQUOIS RIVER AT CHEBANSE—1926-1927.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
1.8	Aug. 11	4.9	Aug. 16	3.1	5	1.92	4	0.56	1.04	1.61	0.62
3.4	Aug. 19	6.0	Aug. 24	2.6	5	1.14	1	1.14	--------	1.28	0.52
2.7	Sept. 1	8.9	Sept. 5	6.2	4	3.65	4	1.33	1.76	1.70	1.55
5.2	Sept. 22	11.7	Sept. 28	6.5	6	3.20	3	1.65	2.13	2.03	1.08
11.1	Oct. 1	16.2	Oct. 5	5.1	4	2.77	4	0.99	1.73	1.84	1.27
3.6	Nov. 11	7.7	Nov. 17	4.1	6	1.91	5	0.78	0.93	2.15	0.68
2.6	Jan. 25	12.2	Feb. 3	9.6	9	1.55	†	1.07	1.20	6.19	1.07
10.3	Feb. 4	12.2	Feb. 6	1.9	2	1.37	2	0.90	1.37	1.39	0.95
3.4	Mar. 6	4.9	Mar. 12	1.5	6	0.40	2	0.23	0.37	3.75	0.25
4.9	Mar. 12	5.9	Mar. 14	1.0	2	0.47	2	0.26	0.46	2.13	0.50
5.0	Mar. 17	12.6	Mar. 21	7.6	4	2.46	2	1.65	0.81	3.09	1.90
4.4	Apr. 1	8.6	Apr. 3	4.2	2	0.61	1	0.61	--------	6.89	2.10
6.2	Apr. 14	11.4	Apr. 18	5.2	4	2.35	6	0.74	1.43	2.21	1.30
5.5	Apr. 27	7.2	Apr. 30	1.7	3	1.18	1	1.12	1.18	1.44	0.57
1.8	May 18	13.5	May 22	11.7	4	2.60	2	1.96	2.60	4.50	2.92
1.4	June 19	4.4	June 22	3.0	3	1.74	1	1.57	1.74	1.72	1.00

† Snow.

ILLINOIS RIVER AT MORRIS—1926-1927.

7.1	Aug. 21	8.2	Aug. 24	1.1	3	0.66	2	0.51	0.66	1.67	0.37
6.7	Sept. 1	11.0	Sept. 6	4.3	5	2.12	5	0.76	1.05	2.03	0.86
7.7	Sept. 23	14.0	Sept. 26	6.3	3	2.59	3	1.63	2.15	2.43	2.10
13.0	Sept. 30	16.2	Oct. 5	3.2	5	1.85	4	0.58	1.08	1.73	0.64
7.2	Nov. 8	8.0	Nov. 10	0.8	2	0.63	1	0.51	0.63	1.27	0.40
7.5	Nov. 13	14.9	Nov. 16	7.4	3	1.74	3	0.61	1.18	4.25	2.47
6.5	Jan. 29	20.0	Feb. 6	13.5	8	2.28	†	0.92	1.08	5.92	1.69
8.1	Mar. 6	9.5	Mar. 9	1.4	3	0.28	1	0.19	0.28	5.00	0.47
9.5	Mar. 19	13.8	Mar. 23	4.3	4	0.95	2	0.70	0.95	4.53	1.07
9.1	Apr. 1	11.9	Apr. 5	2.8	4	0.75	2	0.64	0.75	3.73	0.70
10.2	Apr. 14	14.2	Apr. 17	4.0	3	1.70	4	0.87	1.02	2.35	1.33
14.0	Apr. 18	19.2	Apr. 20	5.2	2	1.41	2	0.86	1.41	3.69	2.60
10.5	Apr. 28	14.3	Apr. 30	3.8	2	1.04	1	1.04	--------	3.65	1.90
7.4	May 18	13.8	May 21	6.4	3	1.63	2	1.10	1.63	3.92	2.13
13.8	May 21	16.9	May 25	3.1	4	1.84	3	1.02	1.44	1.68	1.03
9.5	June 3	16.9	June 5	7.4	2	1.82	3	1.32	1.58	4.06	3.70

† Snow.

ILLINOIS RIVER AT LA SALLE—1926-1927.

7.3	Sept. 1	12.7	Sept. 7	5.4	6	2.30	4	0.85	1.17	2.34	0.90
12.1	Sept. 14	13.6	Sept. 16	1.5	2	0.91	2	0.65	0.91	1.65	0.75
12.2	Sept. 23	17.3	Sept. 25	5.1	2	2.65	3	1.68	2.29	1.93	2.55
16.7	Oct. 1	20.0	Oct. 7	3.3	6	1.81	4	0.65	1.14	1.82	0.55
9.9	Nov. 13	16.9	Nov. 17	7.0	4	1.94	3	0.73	1.46	3.61	1.75
8.6	Jan. 30	19.5	Feb. 7	10.9	8	2.40	†2	0.94	1.09	4.54	1.36
11.6	Mar. 11	13.7	Mar. 15	2.1	4	0.43	1	0.36	0.43	4.89	0.52
12.6	Mar. 20	15.0	Mar. 25	2.4	5	0.91	1	0.74	0.91	2.64	0.48
12.8	Apr. 1	14.5	Apr. 6	1.7	5	0.69	1	0.69	0.78	2.46	0.34
13.3	Apr. 15	20.1	Apr. 21	6.8	6	3.00	7	0.88	1.39	2.26	1.13
16.6	Apr. 28	17.5	May 1	0.9	3	1.08	1	1.00	1.08	0.83	0.30
12.0	May 18	16.0	May 22	4.0	4	1.60	2	1.16	1.60	2.50	1.00
16.0	May 22	19.6	May 26	3.6	4	1.73	3	0.94	1.43	2.08	0.90
15.7	June 3	18.8	June 5	3.1	2	1.39	2	1.14	1.39	2.23	1.55

† Snow.

TABLE NO. A-12—Concluded.

ILLINOIS RIVER AT PEORIA—1926-1927.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
12.3	Aug. 31	17.7	Sept. 10	5.4	10	2.75	5	1.03	1.32	1.97	0.54
17.7	Sept. 14	19.0	Sept. 19	1.3	5	1.00	2	0.68	0.32	1.30	0.67
19.0	Sept. 23	20.8	Sept. 27	1.8	4	2.60	3	1.63	2.28	0.69	0.45
20.8	Sept. 27	25.0	Oct. 9	4.2	12	1.79	4	0.62	1.08	2.34	0.35
15.0	Nov. 13	21.2	Nov. 21	6.2	7	2.09	3	0.86	1.58	2.96	0.89
13.9	Jan. 31	22.6	Feb. 10	8.7	10	1.90	2	0.96	1.12	4.58	0.87
16.5	Mar. 10	18.4	Mar. 20	1.9	10	0.54	1	0.42	0.54	3.52	0.19
18.1	Mar. 21	19.8	Mar. 27	1.7	6	0.93	1	0.75	0.93	1.83	0.28
19.2	Apr. 17	24.7	Apr. 24	5.5	7	2.94	7	0.82	0.95	1.87	0.78
18.3	May 17	21.3	May 23	3.0	6	1.67	2	1.27	0.40	1.80	0.50
21.3	May 23	24.0	May 29	2.7	6	1.69	3	0.93	1.43	1.60	0.45
22.2	June 3	23.8	June 7	1.6	4	1.45	1	1.18	1.45	1.10	0.40

ILLINOIS RIVER AT HAVANA—1926-1927.

10.0	Aug. 30	15.5	Sept. 6	5.5	7	3.59	5	1.43	1.68	1.53	0.79
15.5	Sept. 6	17.8	Sept. 13	2.3	7	1.31	4	0.43	0.80	1.76	0.33
17.8	Sept. 13	19.2	Sept. 18	1.4	5	1.12	2	0.75	1.07	1.25	0.28
17.6	Sept. 24	18.4	Sept. 27	0.8	3	2.47	3	1.44	2.01	0.32	0.27
18.4	Sept. 28	22.7	Oct. 9	4.3	11	2.36	6	0.63	1.16	1.82	0.39
13.4	Nov. 13	17.5	Nov. 22	4.5	9	2.79	6	0.98	1.76	1.56	0.50
17.5	Nov. 22	18.4	Nov. 30	0.9	8	0.21	1	0.18	0.21	4.28	0.11
11.8	Jan. 31	18.1	Feb. 14	6.3	14	1.82	†2	0.85	1.11	3.46	0.45
14.0	Mar. 11	15.0	Mar. 15	1.0	4	0.75	2	0.42	0.70	1.33	0.25
15.1	Mar. 19	17.6	Mar. 28	2.5	9	1.00	2	0.77	1.00	2.50	0.28
17.5	Apr. 1	18.0	Apr. 10	0.5	9	1.36	4	0.79	0.91	0.37	0.06
18.1	Apr. 15	22.0	Apr. 28	3.9	13	2.96	7	0.79	0.93	1.32	0.30
22.0	Apr. 28	21.2	May 1	0.8	3	0.98	1	0.93	0.98	*	0.27
16.9	May 17	19.0	May 21	2.1	4	2.08	2	1.74	2.08	1.01	0.53
19.1	May 23	21.3	May 29	2.2	6	1.89	4	0.93	1.49	1.16	0.37
21.1	June 4	21.8	June 7	0.7	3	1.84	3	1.09	1.43	0.38	0.23

† Snow.
* Fall.

ILLINOIS RIVER AT BEARDSTOWN—1926-1927.

10.0	Aug. 31	16.5	Sept. 7	6.5	7	3.79	5	1.27	2.09	1.71	0.93
16.5	Sept. 7	19.9	Sept. 12	3.4	5	1.49	2	0.75	1.49	2.28	0.68
19.9	Sept. 12	22.1	Sept. 17	2.2	5	1.06	2	0.70	0.98	2.08	0.44
20.4	Sept. 27	25.5	Oct. 6	5.1	9	5.74	12	1.25	1.67	0.69	0.57
25.2	Oct. 7	26.2	Oct. 11	1.0	4	0.25	2	0.14	0.17	4.00	0.50
14.5	Nov. 13	19.4	Nov. 24	4.9	11	2.91	5	0.96	1.79	1.68	0.45
19.4	Nov. 24	20.4	Nov. 30	1.0	6	0.25	†1	0.22	0.25	4.00	0.17
11.9	Feb. 1	19.8	Feb. 14	7.9	13	2.19	2	0.70	0.93	3.61	0.61
15.6	Mar. 11	17.0	Mar. 16	1.4	5	0.71	2	0.36	0.66	1.97	0.27
12.0	Mar. 18	20.5	Mar. 28	3.5	10	1.46	3	0.80	1.23	2.40	1.17
20.1	Apr. 1	20.9	Apr. 4	0.8	3	1.02	1	0.91	1.02	0.78	0.27
21.0	Apr. 11	22.0	Apr. 18	1.0	7	2.41	7	0.66	1.10	0.42	0.14
22.0	Apr. 18	25.2	Apr. 26	3.2	8	1.13	3	0.78	0.92	2.83	0.40
19.4	May 18	20.5	May 21	1.1	3	1.97	2	1.60	1.97	0.55	0.37
20.5	May 21	24.7	May 29	4.2	8	2.27	6	0.93	1.51	1.85	0.53
24.2	June 4	24.9	June 6	0.7	2	1.66	2	0.90	1.24	0.42	0.35

† Snow

TABLE NO. A-13—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—1921-1922.

Stages and dates. From. Stage.	From. Date.	To. Stage.	To. Date.	Rise. Amount, feet.	Rise. Duration, days.	Rainfall. Amount, inches.	Rainfall. Duration, days.	Rainfall. Greatest 1-day.	Rainfall. Greatest 2-day.	Rise per inch of rainfall, feet.	Average rise per day, feet.
7.6	Nov. 18	11.8	Nov. 20	4.2	2	2.11	2	1.23	2.11	1.99	2.20
9.1	Dec. 1	11.5	Dec. 3	2.4	2	0.80	2	0.50	0.80	3.00	1.20
8.6	Dec. 15	12.4	Dec. 18	3.8	3	1.34	3	0.61	1.16	2.84	1.26
8.1	Jan. 3	10.3	Jan. 4	2.2	1	0.91	1	0.91	----	2.42	2.20
7.0	Jan. 23	10.6	Jan. 25	3.6	2	*	----	----	----	----	----
7.0	Feb. 21	9.3	Feb. 25	2.3	4	0.44	4	0.23	0.29	5.23	0.57
7.7	Mar. 10	10.1	Mar. 13	2.4	3	0.66	2	0.41	0.66	3.64	0.80
10.0	Mar. 13	11.6	Mar. 16	1.6	3	0.53	1	0.53	----	3.02	1.60
11.4	Mar. 19	13.8	Mar. 21	2.4	2	0.96	2	0.71	0.96	2.50	1.20
12.1	Mar. 30	17.4	Apr. 2	5.3	3	1.71	2	0.91	1.71	3.10	1.76
13.0	Apr. 10	20.3	Apr. 12	7.3	2	2.10	2	1.38	2.10	3.48	3.65

* Only .05 in. rainfall increase from 6400 c.f.s. to 7300 c.f.s. in Chicago Sanitary District discharges.

ILLINOIS RIVER AT LA SALLE—1921-1922.

7.5	Nov. 18	12.2	Nov. 23	4.7	5	2.06	3	1.05	1.80	2.28	0.94
11.5	Dec. 2	12.8	Dec. 4	1.3	2	0.94	2	0.55	0.94	1.38	0.65
10.7	Dec. 16	13.3	Dec. 19	2.6	3	1.35	3	0.64	1.21	1.93	0.87
11.0	Jan. 2	13.4	Jan. 7	2.4	5	0.93	2	0.88	0.93	2.73	0.42
10.4	Jan. 13	12.5	Jan. 15	2.1	2	*	----	----	----	----	----
7.4	Feb. 13	9.8	Feb. 15	2.4	2	*	----	----	----	----	----
6.8	Feb. 21	9.2	Feb. 25	2.4	4	0.54	4	0.25	0.43	†	----
8.4	Mar. 10	10.2	Mar. 12	1.8	2	0.59	2	0.40	0.59	3.05	0.90
10.7	Mar. 14	12.0	Mar. 16	1.3	2	0.45	1	0.45	----	2.89	0.65
12.7	Mar. 20	13.7	Mar. 21	1.0	1	0.91	3	0.71	0.85	1.10	1.00
13.2	Mar. 26	17.8	Apr. 3	4.6	8	2.47	7	0.81	1.48	1.86	0.57
17.2	Apr. 10	20.0	Apr. 14	2.8	4	1.86	3	1.25	1.78	1.50	0.70

* No rain. (Sanitary District inflow?)
† Probably some Chicago Sanitary District water.

ILLINOIS RIVER AT PEORIA—1921-1922.

12.3	Nov. 17	16.1	Nov. 28	3.8	11	1.72	2	1.00	1.72	2.21	0.35
16.1	Nov. 30	17.4	Dec. 7	1.3	7	1.04	2	0.61	1.04	1.25	0.19
16.2	Dec. 16	17.4	Dec. 21	1.2	5	1.18	2	0.62	1.18	1.02	0.24
15.2	Jan. 3	16.3	Jan. 10	1.0	7	1.00	*1	0.89	0.93	1.00	0.14
12.5	Feb. 22	14.0	Feb. 28	1.5	6	0.52	2	0.25	0.34	2.88	0.25
14.1	Mar. 12	15.0	Mar. 15	0.9	3	0.60	2	0.42	0.60	1.50	0.30
15.0	Mar. 15	16.0	Mar. 18	1.0	3	0.43	1	0.43	----	2.32	0.33
16.0	Mar. 18	17.5	Mar. 23	1.5	5	0.88	2	0.72	0.84	1.71	0.30
17.5	Mar. 24	18.6	Mar. 29	1.1	5	0.99	4	0.28	0.45	1.11	0.22
18.6	Mar. 29	23.2	Apr. 8	4.6	10	1.43	2	0.80	1.43	3.22	0.46
22.9	Apr. 11	24.8	Apr. 15	1.9	4	1.67	2	1.11	1.67	1.14	0.48

* Thaw.

ILLINOIS RIVER AT BEARDSTOWN—1921-1922.

9.0	Nov. 18	14.0	Dec. 5	5.0	17	3.04	17	0.98	1.84	1.65	0.29
11.2	Mar. 12	13.0	Mar. 15	1.8	3	1.04	2	1.02	1.04	1.74	0.60
14.8	Mar. 19	16.2	Mar. 21	1.4	2	0.91	2	0.79	0.91	1.54	0.70
18.8	Mar. 31	19.9	Apr. 4	1.1	4	1.54	2	0.80	1.54	0.68	0.27
22.4	Apr. 11	24.7	Apr. 16	2.3	5	1.99	5	0.89	1.49	1.15	0.46

TABLE NO. A-13—Concluded.

ILLINOIS RIVER AT HAVANA—1921-1922.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
9.4	Nov. 16	14.0	Dec. 7	4.6	21	3.19	17	0.87	1.05	1.44	0.22
11.4	Mar. 11	16.1	Mar. 82	4.7	17	2.96	19	0.68	0.81	1.58	0.27
16.5	Mar. 30	17.5	Apr. 3	1.0	4	1.41	2	0.77	1.41	1.41	0.25
19.9	Apr. 11	22.2	Apr. 17	2.3	6	2.07	7	0.95	1.50	1.11	0 38

TABLE NO. A-14—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—1915-1916.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date	Stage.	Date.								
5.6	Jan. 1	11.1	Jan. 5	5.5	4	1.60	†1	0.76	0.79	3.44	1.37
8.8	Jan. 16	22.9	Jan. 22	14.1	6	2.42	†	0.89	1.04	5.83	2.35
12.3	Jan. 30	14.9	Feb. 1	2.6	2	0.97	2	0.56	0.77	2.68	1.30
9.1	Feb. 8	12.9	Feb. 11	3.8	3	0.19	------	0.09	0.14		--------

† Thaw.

ILLINOIS RIVER AT LA SALLE—1915-1916.

5.9	Dec. 18	8.0	Dec. 23	2.1	5	0.67	†	0.35	0.48	3.12	0.42
6.1	Dec. 27	8.5	Dec. 29	2.4	2	0.47	†	0.22	0.47	5.11	1.20
6.0	Jan. 1	10.8	Jan. 6	4.8	5	0.84	1	0.79	0.84	5.71	0.96
9.1	Jan. 12	13.7	Jan. 16	4.6	4	1.04	2	0.86	0.98	4.42	1.15
9.8	Jan. 19	23.1	Jan. 23	*13.3	4	1.39	†2	0.93	1.07	9.56	*3.33

* Probably due to Chicago Sanitary District water.
† Thaw.

ILLINOIS RIVER AT PEORIA—1915-1916.

10.7	Jan. 1	14.3	Jan. 10	3.6	9	1.37	*2	0.79	0.84	2.63	0.40
15.3	Jan. 20	23.2	Jan. 25	7.9	5	2.51	*2	1.01	1.14	3.15	1.58

* Snow.

ILLINOIS RIVER AT HAVANA—1915-1916.

8.9	Jan. 1	10.7	Jan. 5	1.8	4	1.31	*1	0.87	0.91	1.38	0.45
12.6	Jan. 21	18.2	Jan. 26	5.6	5	2.66	*3	1.02	1.21	2.10	1.12
18.2	Jan. 26	19.5	Jan. 31	1.3	5	1.31	4	0.42	0.80	0.99	0.26

* Snow.

ILLINOIS RIVER AT BEARDSTOWN—1915-1916.

9.4	Jan. 1	11.8	Jan. 5	2.4	4	1.44	*2	0.85	0.88	1.67	0.60
12.5	Jan. 20	18.2	Jan. 26	5.7	6	2.71	*	1.04	1.32	2.10	0.95
18.2	Jan. 26	20.5	Jan. 31	2.3	5	1.61	4	0.59	1.00	1.43	0.46

* Snow.

TABLE NO. A-15—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—1913.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
10.7	Apr. 9	13.8	Apr. 11	3.1	2	1.26	2	0.79	1.01	2.46	1.55

NOTE.—No gauge readings to March 24, 1913, from January 1, 1913.

ILLINOIS RIVER AT LA SALLE—1913.

4.5	Jan. 5	9.0	Jan. 8	4.5	3	0.83	3	0.41	0.70	5.42	1.50
7.3	Jan. 20	11.7	Jan. 26	4.4	6	1.04	*	0.48	0.51	4.23	0.73
9.2	Feb. 21	12.7	Feb. 23	3.5	2	0.71	2	0.47	0.71	4.93	1.75
9.7	Mar. 8	13.2	Mar. 10	3.5	2						
11.8	Mar. 13	12.9	Mar. 15	1.1	2	0.37	1	0.28	0.37	2.97	0.55
11.2	Mar. 21	12.3	Mar. 22	1.1	1	0.78	2	0.67	0.78	1.41	1.10
12.3	Mar. 23	19.3	Mar. 29	7.0	6	2.57	4	1.07	1.75	2.72	1.17
15.4	Apr. 9	16.7	Apr. 12	1.3	3	1.29	3	0.73	1.05	1.01	0.43

* Thaw.
NOTE.—Did not have temperatures for 1913.

ILLINOIS RIVER AT PEORIA—1913.

10.8	Jan. 17	12.0	Jan. 21	1.2	4	0.63	3	0.44	0.47	1.91	0.30
12.0	Jan. 22	15.0	Jan. 28	3.0	6	0.96	*1	0.45	0.46	3.12	0.50
12.9	Feb. 21	14.3	Feb. 25	1.4	4	0.85	2	0.62	0.85	1.65	0.35
13.3	Mar. 9	16.6	Mar. 17	3.3	8	1.35	*2	0.26	0.37	2.45	0.41
16.6	Mar. 23	22.3	Mar. 30	5.7	7	3.07	5	1.07	1.70	1.85	0.82
21.0	Apr. 11	21.5	Apr. 13	0.5	2	1.04	2	0.73	1.04	0.48	0.25

* Thaw.

ILLINOIS RIVER AT HAVANA—1913.

9.7	Jan. 23	12.3	Feb. 1	2.6	8	1.24	*	0.47	0.49	2.10	0.33
11.2	Feb. 20	12.8	Feb. 24	1.6	4	0.98	2	0.79	0.98	1.63	0.40
11.3	Mar. 8	13.6	Mar. 18	2.3	10						
12.3	Mar. 22	19.9	Apr. 3	7.6	12	3.15	5	1.06	1.65	2.38	0.63

* Thaw.

ILLINOIS RIVER AT BEARDSTOWN—1913.

11.3	Feb. 21	12.8	Feb. 28	1.5	7	0.84	2	0.69	0.84	1.79	0.21
11.6	Mar. 9	13.2	Mar. 20	1.6	11		*				
13.2	Mar. 20	21.9	Apr. 5	8.7	16	3.71	7	1.13	1.82	2.35	0.54

* Thaw.
NOTE.—No gauge readings to February 1, 1913.

TABLE NO. A-16—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—1904.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
5.7	Jan. 20	14.0	Jan. 22	8.3	2	2.29	*	1.12	1.59	3.62	4.15
8.0	Feb. 6	13.6	Feb. 8	5.6	2	0.91	*	0.20	0.21	6.15	2.80
7.0	Feb. 28	16.7	Mar. 4	9.7	5	1.72	*	0.47	0.54	5.54	1.94
14.2	Mar. 6	15.5	Mar. 8	1.3	2	0.37	1	0.34	0.37	3.51	0.65
8.8	Mar. 18	15.0	Mar. 20	6.2	2	1.19	3	0.58	0.66	5.21	3.10
15.0	Mar. 22	16.9	Mar. 23	1.9	1	0.78	2	0.41	0.78	2.44	1.90
17.0	Mar. 24	20.2	Mar. 26	3.2	2	1.25	2	0.85	1.25	2.56	1.60
14.8	Mar. 31	16.8	Apr. 2	2.0	2	1.19	3	0.51	0.96	1.68	1.00
6.4	Apr. 23	11.6	Apr. 28	5.2	5	2.18	5	0.80	1.31	2.38	1.04

* Thaw.

ILLINOIS RIVER AT LA SALLE—1904.

13.6	Jan. 19	23.2	Jan. 23	9.6	4	1.81	*2	1.00	1.49	5.31	2.40
17.7	Feb. 5	22.7	Feb. 9	5.0	4	0.71	*	0.15	0.23	7.05	1.25
16.8	Feb. 28	24.8	Mar. 4	8.0	5	1.50	*	0.47	0.51	5.33	1.60
23.8	Mar. 7	25.7	Mar. 9	1.9	2	0.40	1	0.30	0.34	4.75	0.95
21.8	Mar. 19	27.1	Mar. 23	5.3	4	1.46	6	0.60	0.76	3.63	1.32
26.8	Mar. 24	29.3	Mar. 27	2.5	3	1.03	2	0.84	1.03	2.43	0.83
18.8	Apr. 23	20.9	Apr. 28	2.1	5	1.98	5	0.65	1.27	1.06	0.42

* Thaw.

ILLINOIS RIVER AT PEORIA—1904.

10.0	Jan. 20	16.2	Jan. 28	6.2	8	1.91	*2	1.04	1.51	3.24	0.76
15.2	Feb. 6	16.6	Feb. 11	1.4	5	0.57	*1	0.11	0.12	2.46	0.28
13.5	Feb. 28	18.5	Mar. 11	5.0	12	2.11	*1	0.27	0.33	2.37	0.42
17.1	Mar. 19	18.2	Mar. 21	1.1	2	0.64	1	0.58	0.64	1.72	0.56
18.2	Mar. 21	23.0	Mar. 28	4.8	7	1.91	5	0.77	1.06	2.51	0.69
15.4	Apr. 24	16.2	Apr. 29	0.8	5	1.55	3	0.65	1.25	0.52	0.16

* Thaw.

ILLINOIS RIVER AT HAVANA—1904.

8.6	Jan. 20	14.3	Jan. 27	5.7	7	2.17	*2	1.09	1.56	2.62	0.82
13.0	Feb. 29	15.5	Mar. 14	2.5	14	1.31	*	0.41	0.49	1.91	0.18
15.2	Mar. 19	19.9	Mar. 31	4.7	12	2.59	9	0.67	1.07	1.82	0.39

* Thaw.

ILLINOIS RIVER AT BEARDSTOWN—1904.

8.6	Jan. 20	15.0	Feb. 1	6.4	12	2.46	*2	1.00	1.52	2.60	0.53
14.3	Mar. 1	15.2	Mar. 7	0.9	6	1.25	*	0.41	0.47	0.72	0.15
15.4	Mar. 21	18.5	Mar. 29	3.1	8	2.21	5	0.88	1.23	1.40	0.39
18.5	Mar. 29	20.0	Apr. 4	1.5	6	1.07	3	0.45	0.82	1.40	0.25
15.6	Apr. 25	16.3	Apr. 27	0.7	2	1.82	3	0.80	1.46	0.39	0.35

* Thaw.

TABLE NO. A-17—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—1900.

Stages and dates.				Rise.		Rainfall.				Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Greatest 1-day.	Greatest 2-day.		
Stage.	Date.	Stage.	Date.								
2.1	Jan. 17	6.2	Jan. 27	4.1	10	0.93	*2	0.30	0.57	4.41	0.41
3.5	Feb. 2	4.3	Feb. 4	0.8	2	0.67	1	0.61	0.67	1.19	0.40
4.3	Feb. 7	12.7	Feb. 9	8.4	2	0.90	2	0.53	0.88	9.34	†4.20
9.7	Feb. 13	10.7	Feb. 14	1.0	1	0.29	1	0.20	0.29	3.45	1.00
8.7	Feb. 20	12.0	Feb. 23	3.3	3	0.64	*1	0.47	0.49	5.16	1.10
6.0	Mar. 6	19.5	Mar. 12	13.5	6	2.52	*	0.97	1.06	5.31	2.25
8.4	Mar. 29	12.9	Apr. 2	4.5	4	0.84	3	0.41	0.72	5.36	1.12
5.6	Apr. 16	7.3	Apr. 19	1.7	3	0.54	2	0.28	0.42	3.15	0.57
4.1	May 7	5.5	May 12	1.4	5	1.39	3	0.56	1.04	1.01	0.28
3.1	May 20	4.9	May 23	1.8	3	0.94	3	0.40	0.73	1.92	0.60

* Thaw.
† May be due to Chicago Sanitary District water.

ILLINOIS RIVER AT LA SALLE—1900.

NOTE —No gage readings for LaSalle, 1900.

ILLINOIS RIVER AT PEORIA—1900.

5.1	Jan. 18	8.1	Jan. 26	3.0	8	0.75	2	0.38	0.37	4.00	0.38
7.6	Feb. 7	11.5	Feb. 13	3.9	6	1.05	2	0.72	1.05	3.71	0.65
10.4	Feb. 23	12.3	Feb. 25	1.9	2	0.54	1	0.50	0.54	3.52	0.95
11.3	Mar. 8	19.9	Mar. 16	8.6	8	2.12	*2	0.61	1.07	4.05	1.08
15.7	Mar. 31	16.9	Apr. 5	1.2	5	0.93	2	0.42	0.81	1.29	0.24

* Thaw.

ILLINOIS RIVER AT HAVANA—1900.

4.5	Jan. 16	6.9	Jan. 24	2.4	8	0.87	2	0.52	0.87	2.30	0.30
7.0	Feb. 2	10.0	Feb. 11	3.0	9	1.64	5	0.72	1.07	1.83	0.33
10.0	Feb. 20	11.6	Mar. 2	1.6	10	0.57	1	0.54	0.57	3.86	0.16
11.0	Mar. 9	17.4	Mar. 18	6.4	9	2.09	*	0.90	1.03	3.06	0.71

* Snow.

ILLINOIS RIVER AT BEARDSTOWN—1900.

6.9	Jan. 15	8.5	Jan. 19	1.6	4	0.83	2	0.52	0.83	1.93	0.40
7.7	Feb. 1	10.2	Feb. 13	2.5	12	1.81	5	0.75	1.09	1.38	0.21
9.9	Feb. 20	11.4	Feb. 23	1.5	3	0.61	1	0.58	0.61	2.46	0.50
9.5	Mar. 2	17.7	Mar. 19	8.2	17	2.39	7	1.14	1.25	3.47	0.48

TABLE NO. A-18—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT MORRIS—FLOOD PERIOD, JANUARY-JUNE, 1898.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
1.6	Jan. 19	6.5	Jan. 29	4.9	10	1.68	5	0.90	2.92	0.49
4.9	Feb. 6	9.1	Feb. 12	4.2	6	1.60	------	0.73	2.62	1.20
5.6	Feb. 19	8.8	Feb. 21	3.2	2	0.91	3	*0.72	3.52	1.60
4.2	Mar. 6	11.0	Mar. 14	6.8	8	1.17	4	*0.86	5.11	0.85
7.7	Mar. 18	14.7	Mar. 20	7.0	2	1.21	2	1.21	5.78	3.50
10.0	Mar. 26	16.5	Mar. 28	6.5	2	1.22	3	1.15	4.33	3.25

* Unknown amount of melting snow.

ILLINOIS RIVER AT LA SALLE—FLOOD PERIOD, JANUARY-JUNE, 1898.

11.0	May 14	13.4	May 17	2.4	3	1.10	3	0.98	2.18 } 2.61	
13.4	May 17	19.4	May 23	6.0	6	2.12	4	1.26	2.83 }	
12.8	June 9	13.9	June 13	1.1	4	1.85	7	0.55	0.60	
11.0	June 25	13.2	June 28	2.2	3	1.12	1	1.12	1.97	

ILLINOIS RIVER AT PEORIA—FLOOD PERIOD, JANUARY-JUNE, 1898.

4.0	Jan. 11	5.3	Jan. 16	1.3	5	1.15	4	0.72	1.13	0.26
5.1	Jan. 19	7.2	Jan. 24	2.1	5	2.04	5	1.02	1.03	0.42
7.2	Jan. 24	7.9	Feb. 2	0.7	9	0.71	1	0.71	0.99	0.08
6.9	Feb. 10	13.3	Feb. 23	6.4	13	†1.91	14	0.85	3.34	0.50
11.6	Mar. 9	15.8	Mar. 17	4.2	8	1.31	6	0.83	3.21	0.52
15.6	Mar. 18	17.4	Mar. 23	1.8	5	1.90	5	1.40	0.95	0.36
17.0	Mar. 26	19.4	Apr. 1	2.4	6	1.41	3	1.32	1.70	0.40
8.8	May 15	14.2	May 26	5.4	11	3.32	8	1.27	1.61	0.49

† Doubtful.

ILLINOIS RIVER AT HAVANA—FLOOD PERIOD, JANUARY-JUNE, 1898.

3.2	Jan. 7	5.8	Jan. 14	2.6	7	0.95	4	0.75	2.74	0.37
5.2	Jan. 18	6.4	Jan. 23	1.2	5	2.04	5	0.98	0.59	0.24
6.3	Jan. 24	7.4	Feb. 4	1.1	11	0.75	1	0.75	1.47	0.10
7.0	Feb. 10	11.4	Feb. 28	4.4	18	†1.82	12	0.90	2.42	0.25
10.8	Mar. 10	14.9	Mar. 27	4.1	17	3.25	13	1.32	1.26	0.24
14.9	Mar. 27	18.0	Apr. 2	3.1	6	1.48	2	1.48	2.08	0.51
9.7	May 15	13.8	May 26	4.1	11	3.59	8	1.07	1.14	0.37

† Doubtful.

ILLINOIS RIVER AT BEARDSTOWN—FLOOD PERIOD, JANUARY-JUNE, 1898.

11.4	Mar. 11	12.0	Mar. 15	0.6	4	1.30	4	0.97	4.62 }	0.15
12.0	Mar. 16	13.4	Mar. 21	1.4	5	1.15	3	1.09	0.94 } 1.62	0.28
13.4	Mar. 22	14.8	Mar. 26	1.4	4	0.88	2	0.88	1.59 }	0.35
14.8	Mar. 26	19.9	Apr. 1	5.1	6	1.91	2	1.91	2.67 }	0.85
10.8	May 14	11.5	May 18	0.7	4	1.24	3	1.01	0.56 } 0.96	0.17
11.5	May 18	15.4	May 30	3.9	12	3.53	13	1.40	1.11 }	0.32

TABLE NO. A-18—Concluded.

ILLINOIS RIVER AT PEARL—FLOOD PERIOD, JANUARY-JUNE, 1898.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
9.1	Mar. 11	9.6	Mar. 14	0.5	3	1.35	4	1.00	0.37} 0.47	0.17} 0.14
9.6	Mar. 15	9.8	Mar. 17	0.2	2	0.12	1	0.12	1.67}	0.10}
9.8	Mar. 18	10.8	Mar. 21	1.0	3	1.09	2	1.09	0.92	0.33
10.8	Mar. 22	13.2	Mar. 25	2.4	3	0.94	3	0.88	2.56	0.80
13.2	Mar. 26	18.3	Apr. 6	5.0	11	1.96	3	1.91	2.76	0.45
	Mar. 11		Apr. 6	*9.1	*22	*5.46				
9.3	May 13	10.0	May 16	0.7	3	1.30	3	1.06	0.54} 1.07	0.23} 0.38
10.1	May 19	13.6	May 27	3.5	8	2.61	4	1.50	1.34}	0.44}

* Sum.

ILLINOIS RIVER AT GRAFTON—FLOOD PERIOD, JANUARY-JUNE, 1898.

4.6	Jan. 9	5.4	Jan. 13	0.8	4	1.20	4	0.79	0.67	0.20
4.4	Jan. 19	5.7	Jan. 23	1.3	4	2.08	4	1.02	0.63	0.32
5.5	Jan. 24	5.9	Jan. 27	0.4	3	0.68	1	0.68	0.59	0.13
3.0	Feb. 4	4.7	Feb. 9	1.7	5	(Miss. R.)	------	----------	----------	0.34
4.7	Feb. 10	9.2	Feb. 21	4.5	11	(Miss. R.)	------	----------	----------	0.41
5.9	Mar. 10	12.9	Mar. 15	7.0	5	1.34	4	1.01	5.21	1.40
12.3	Mar. 18	17.2	Mar. 23	4.9	5	2.14	5	1.09	2.29	0.98
13.8	Mar. 26	16.3	Mar. 29	2.5	3	1.94	2	1.89	1.32	0.83
12.5	Apr. 13	13.7	Apr. 16	1.2	3	0.79	1	0.79	1.52	0.40
9.2	May 14	13.6	May 17	4.4	3	1.30	3	1.05	3.37	1.47
13.2	May 20	18.1	May 23	4.9	3	2.64	4	1.46	1.85	1.63
10.3	June 10	--------	----------	----------	------	----------	------	----------	----------	----------

NOTE.—Rises on February 9 and 21, on May 5 and on June 14 were due to Mississippi River stages.

TABLE NO. A-19—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT PEORIA—FLOOD PERIOD, JANUARY-JULY, 1893.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
4.6	Feb. 12	13.8	Feb. 24	9.2	12	†4.62	†7	3.58*	1.99	0.76
13.1	Mar. 1	16.0	Mar. 9	2.9	8	†0.57	2	0.57	5.09	0.36
16.0	Mar. 9	19.9	Mar. 15	3.9	6	†1.02	2	1.02	3.83	0.65
11.6	Apr. 18	15.4	Apr. 26	3.8	8	3.25	10	1.09	3.48	0.48
15.4	Apr. 26	16.5	May 6	1.1	10	1.33	4	0.79	0.82	----------
	Apr. 18		May 6	4.9		4.58			1.07	

* Amount of accumulated snow (water equivalent).
† Doubtful.

TABLE NO. A-19—Concluded.

ILLINOIS RIVER AT BEARDSTOWN—FLOOD PERIOD, JANUARY-JULY, 1893.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
6.3	Feb. 11	13.9	Feb. 28	7.6	17	*4.26	†7	3.18	1.77	0.45
14.0	Mar. 8	17.0	Mar. 14	3.0	6	†1.86	10	1.24	2.41	0.50
12.4	Apr. 17	16.8	May 5	4.4	18	5.14	15	1.41	0.85	0.24
13.3	May 25	13.9	May 28	0.6	3	1.17	2	1.17	0.52	0.20
13.6	May 30	14.3	June 2	0.7	3	0.96	3	0.87	0.81	0.23

* Accumulated snow.
† Doubtful.

ILLINOIS RIVER AT PEARL—FLOOD PERIOD, JANUARY-JULY, 1893.

2.0	Feb. 11	9.7	Feb. 18	7.7	7	*4.13	7	*3.05	1.86	1.10
9.7	Feb. 19	12.0	Feb. 27	2.3	8	*0.44	2	0.44	5.23	0.29
	Feb. 11		Feb. 27	‡10.0	‡16	‡4.57			2.18	0.62
11.6	Mar. 7	15.8	Mar. 17	4.2	10	1.41	3	1.37	2.98	0.42
11.1	Apr. 19	18.1	May 4	7.0	15	5.19	15	1.39	1.36	0.46
14.0	May 25	15.6	May 29	1.6	4	1.40	2	1.40	1.15	0.40
4.8	July 9	5.7	July 10	0.9	1	0.67	1	0.67	1.34	0.90

* Accumulated snow.
‡ Sum.

TABLE NO. A-20—RAINFALL AND RIVER STAGE RELATION BY INDIVIDUAL STORM PERIODS.

ILLINOIS RIVER AT PEORIA—FLOOD PERIOD, MARCH-AUGUST, 1892.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
7.0	Mar. 26	7.9	Mar. 30	0.9	4	0.60	2	0.60	1.50	0.22
7.9	Mar. 31	8.5	Apr. 4	0.6	4	0.39	1	0.39	1.54	0.15
8.5	Apr. 4	14.5	Apr. 12	6.0	8	2.06	5	1.53	2.90	0.75
	Mar. 26		Apr. 12	*7.5	*16	*3.05			(2.45)	(0.47)
10.9	May 2	21.9	May 9	11.0	7	5.34	9	1.99	2.06	1.57
14.4	June 18	15.6	June 22	1.2	4	2.50	4	1.75	0.48	0.30
15.6	June 23	18.5	June 28	2.9	5	3.40	8	1.87	0.85	0.58
	June 18		June 28	*4.1	*9	*5.90			(0.70)	(0.46)

Note sharp crests at Peoria as compared to broad crests in later floods.
* Sum.

TABLE NO. A-20—Concluded.

ILLINOIS RIVER AT BEARDSTOWN—FLOOD PERIOD, MARCH-AUGUST, 1892.

Stages and dates.				Rise.		Rainfall.			Rise per inch of rainfall, feet.	Average rise per day, feet.
From.		To.		Amount, feet.	Duration, days.	Amount, inches.	Duration, days.	Maximum 1 and 2 day, inches.		
Stage.	Date.	Stage.	Date.							
8.8	Apr. 1	11.8	Apr. 8	3.0	7	0.76	5	0.42	3.95	0.43
11.8	Apr. 9	14.2	Apr. 13	2.4	4	1.97	2	1.81	1.22	0.60
	Apr. 1		Apr. 13	*5.4	*11	*2.73			(1.98)	(0.49)
12.6	May 3	18.4	May 15	5.8	12	4.06	7	1.63	1.43	0.48
13.8	June 23	15.4	July 3	1.6	10	4.89	11	1.77	0.33	0.16

Note effect of Sangamon on prolonged stages at Beardstown.
Note lag in run-off as compared to later floods.

ILLINOIS RIVER AT PEARL—FLOOD PERIOD, MARCH-AUGUST, 1892.

5.2	Apr. 2	11.2	Apr. 7	6.0	5	2.77	8	1.83	2.17	1.20
11.2	Apr. 12	13.7	Apr. 23	2.5	11	1.83	9	0.75	1.37	0.23
11.4	May 4	20.4	May 19	9.0	15	6.30	20	1.52	1.43	0.60
14.3	June 27	17.6	July 7	3.3	10	6.73	21	1.68	0.49	0.33

ILLINOIS RIVER AT GRAFTON—FLOOD PERIOD, MARCH-AUGUST, 1892.

198.0	Apr. 1	207.2	Apr. 7	9.2	6	2.21	3	2.05	4.48	1.53
202.9	Apr. 14	207.0	Apr. 23	4.1	9	2.67	9	2.11	1.53	0.46
203.2	May 1	215.8	May 19	12.6	18	5.95	18	1.76	2.11	0.70
209.6	June 27	213.6	July 8	4.0	11	3.92	13	2.37	1.08	0.36

RAINFALL AND RIVER STAGES
MARCH 1—AUGUST 31, 1892, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY JACOB A. HARMAN, Consulting Engineer

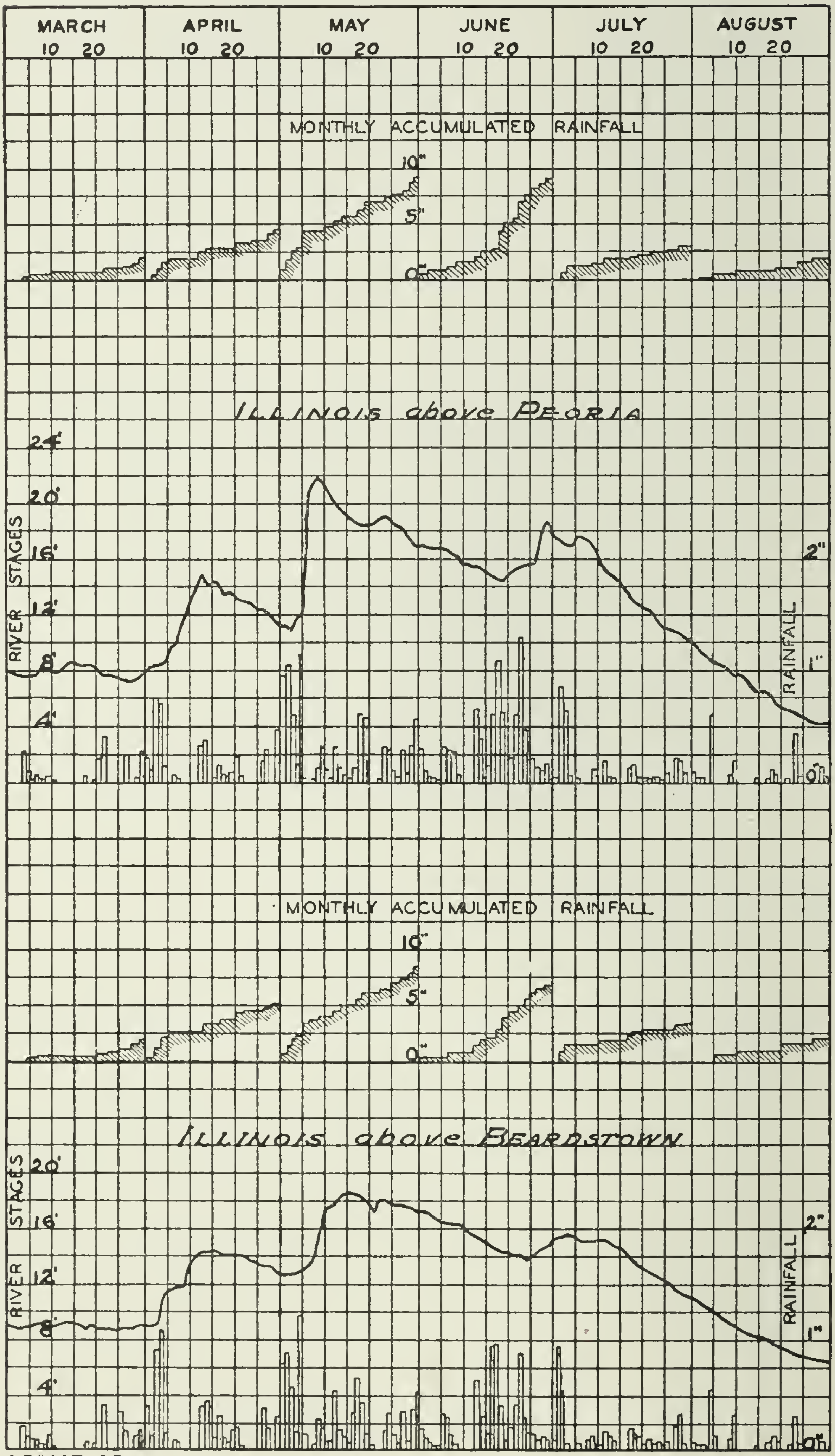


FIGURE A1

RAINFALL AND RIVER STAGES
MARCH 1—AUGUST 31, 1892, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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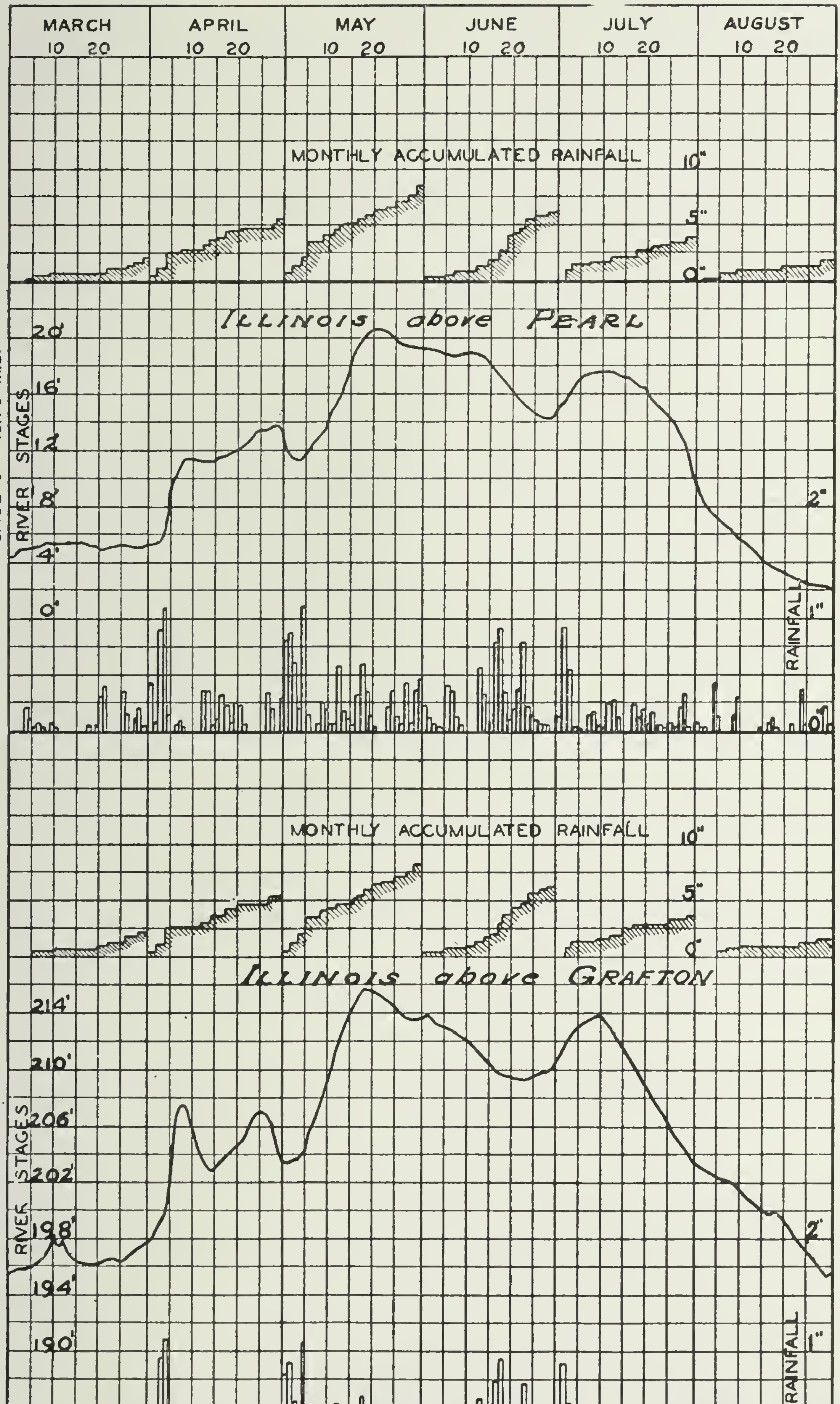

FIGURE A 2

RAINFALL AND RIVER STAGES
JANUARY 1893—JULY 1893, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
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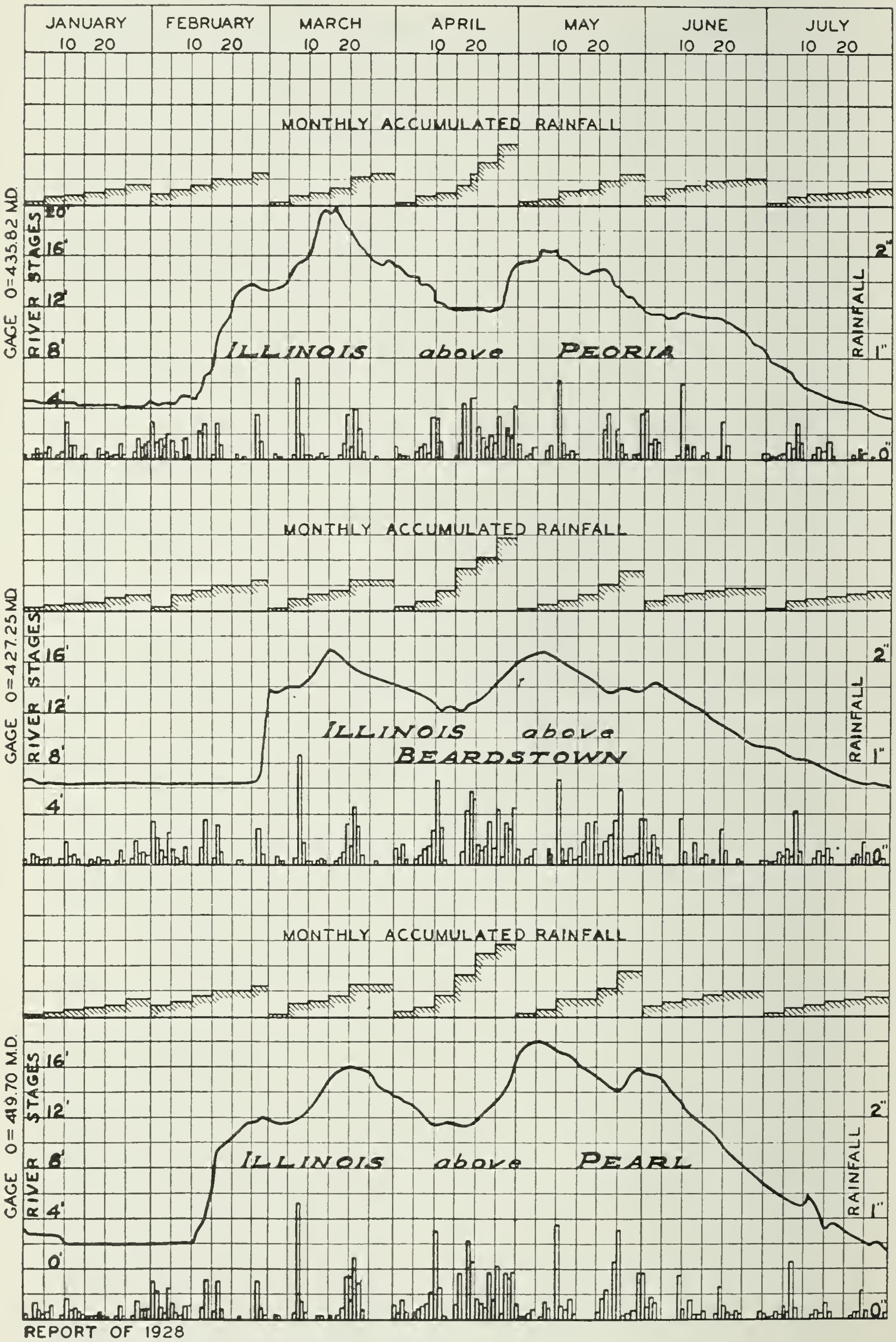

FIGURE A 3

RAINFALL AND RIVER STAGES
JANUARY 1898—JUNE 1898, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
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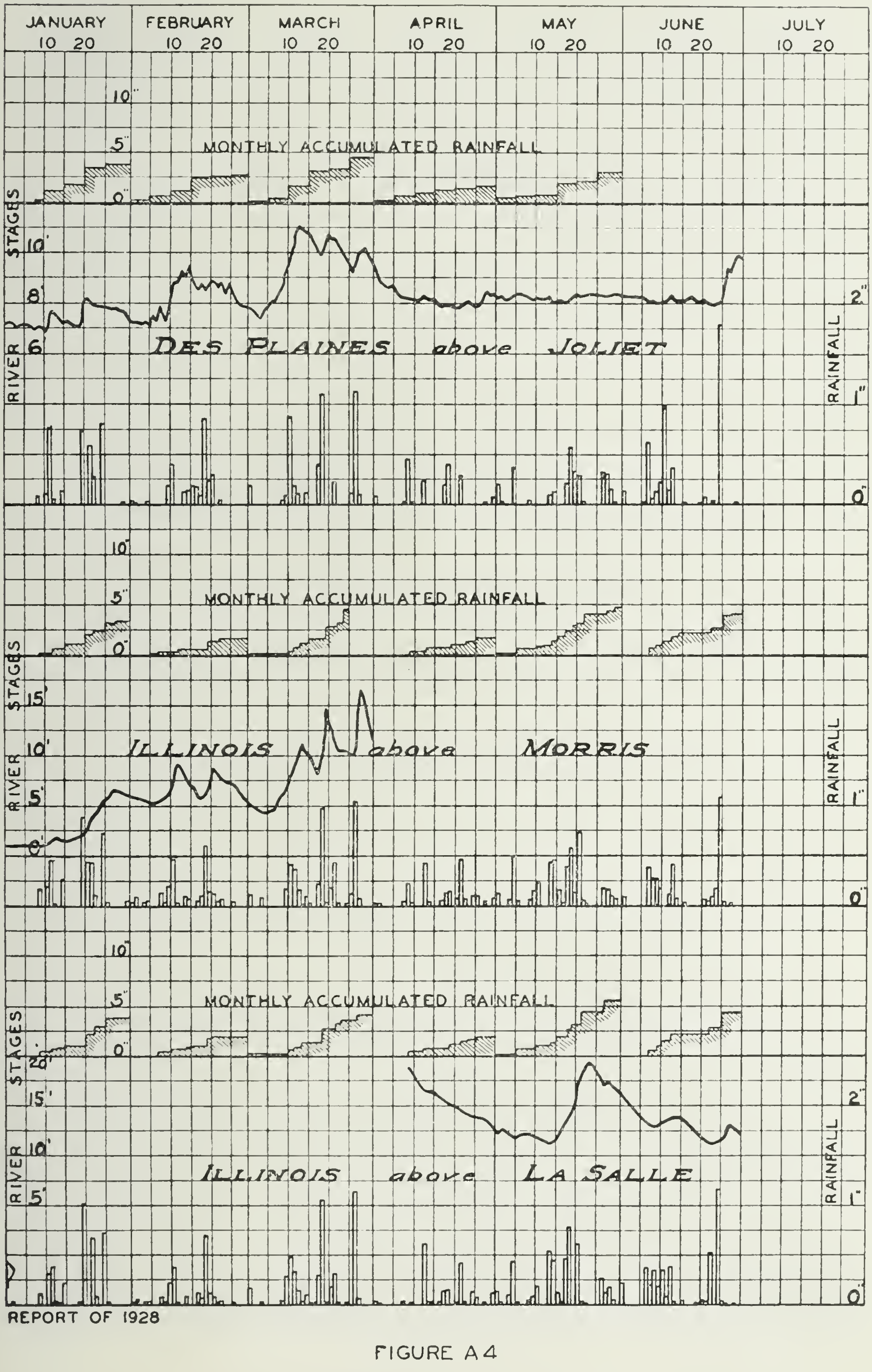

FIGURE A4

RAINFALL AND RIVER STAGES
JANUARY 1898—JUNE 1898, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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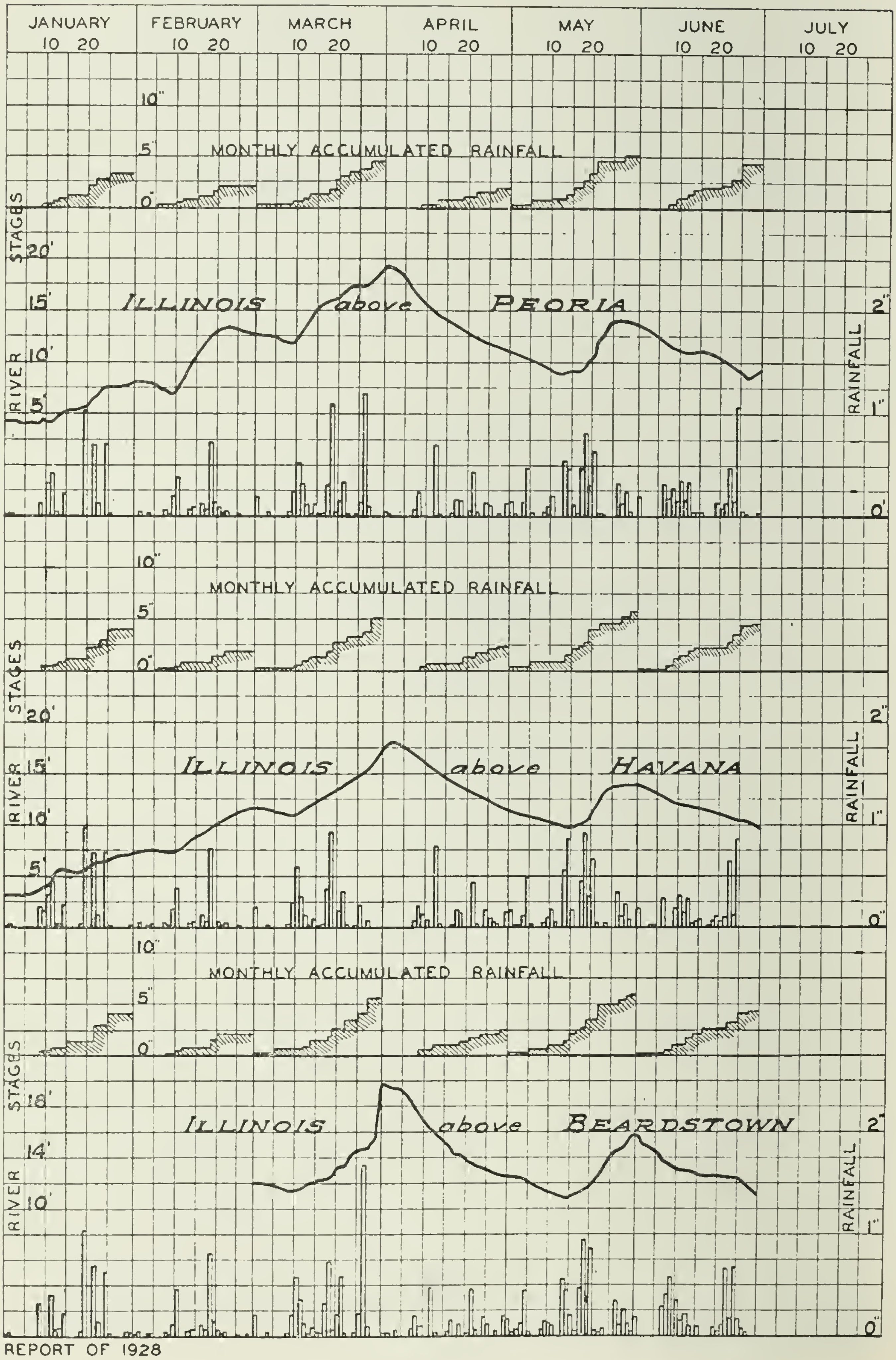

FIGURE A5

RAINFALL AND RIVER STAGES
JANUARY 1898—JUNE 1898, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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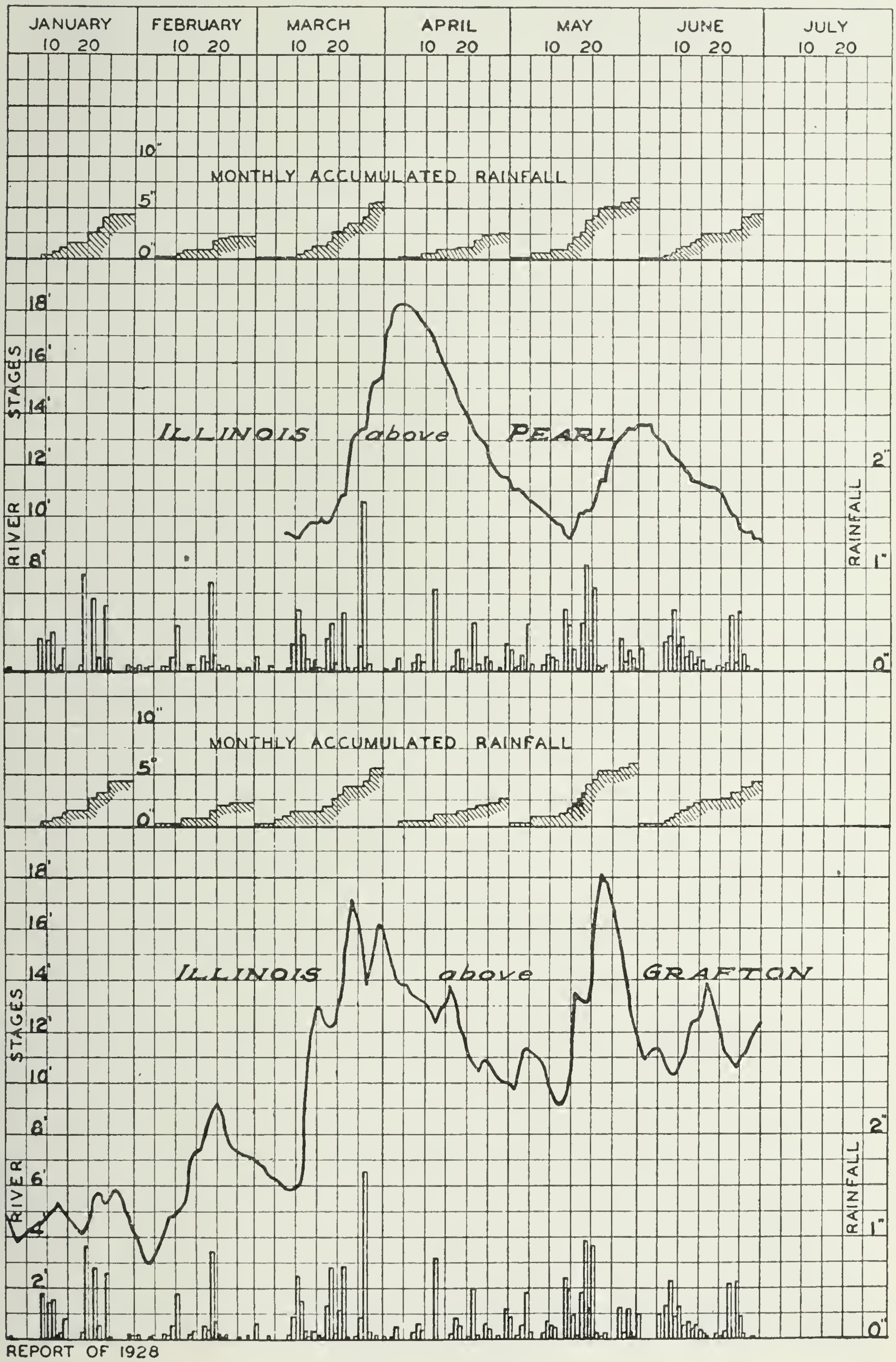

FIGURE A6

RAINFALL AND RIVER STAGES
JANUARY 1900—MAY 1900, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

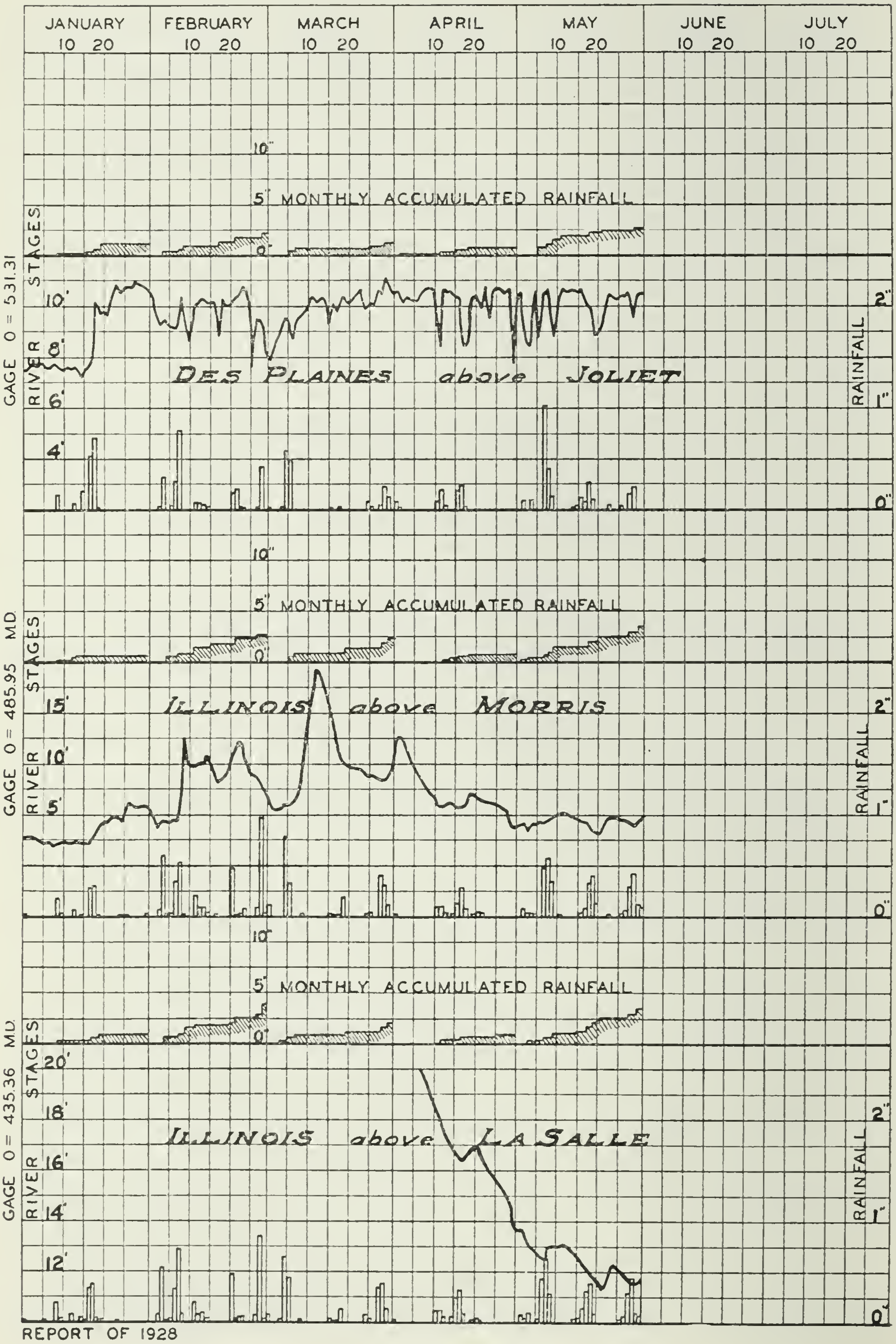

FIGURE A7

RAINFALL AND RIVER STAGES
JANUARY 1900—MAY 1900, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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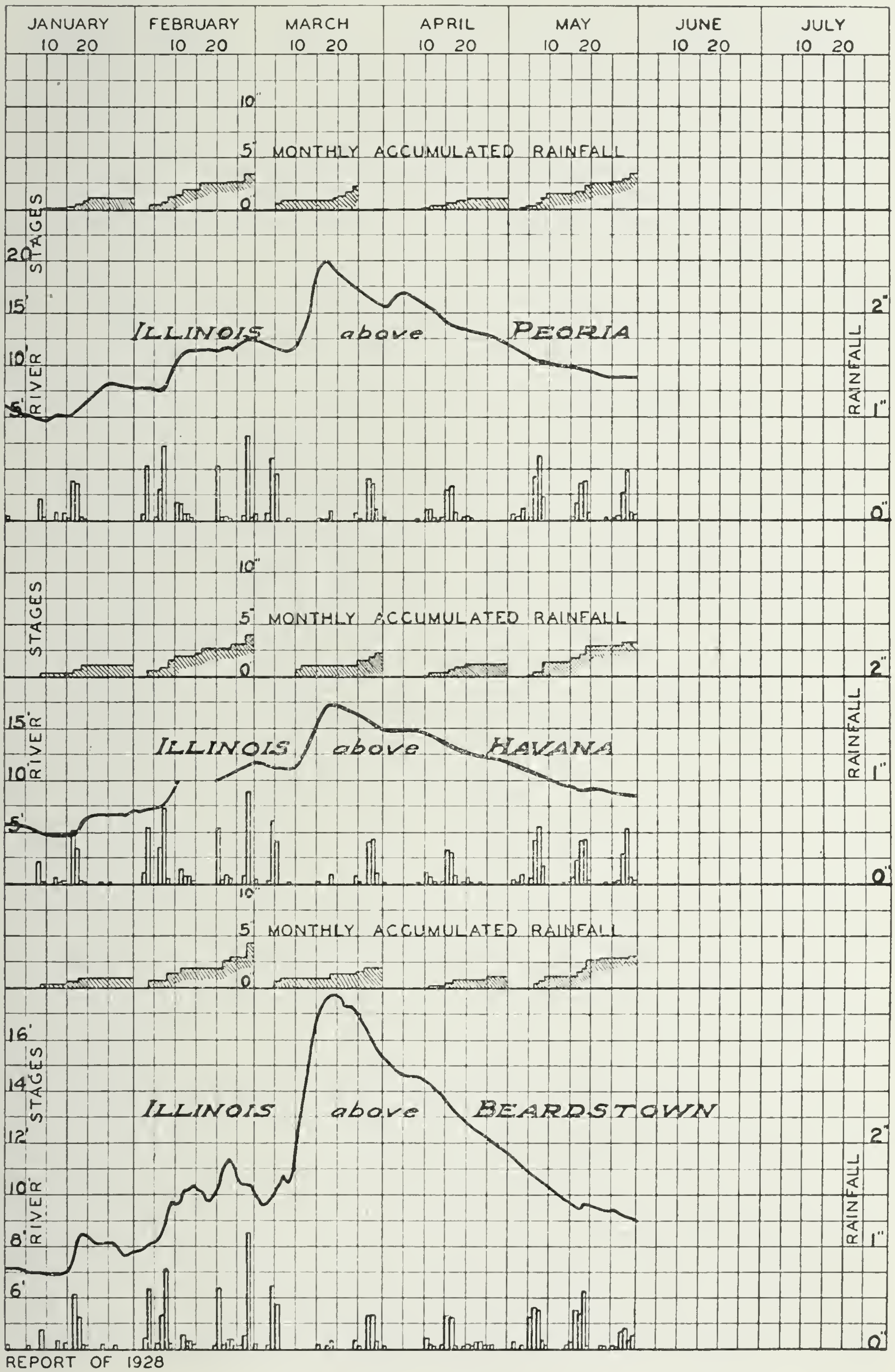

FIGURE A8

RAINFALL AND RIVER STAGES
JANUARY 1900—MAY 1900, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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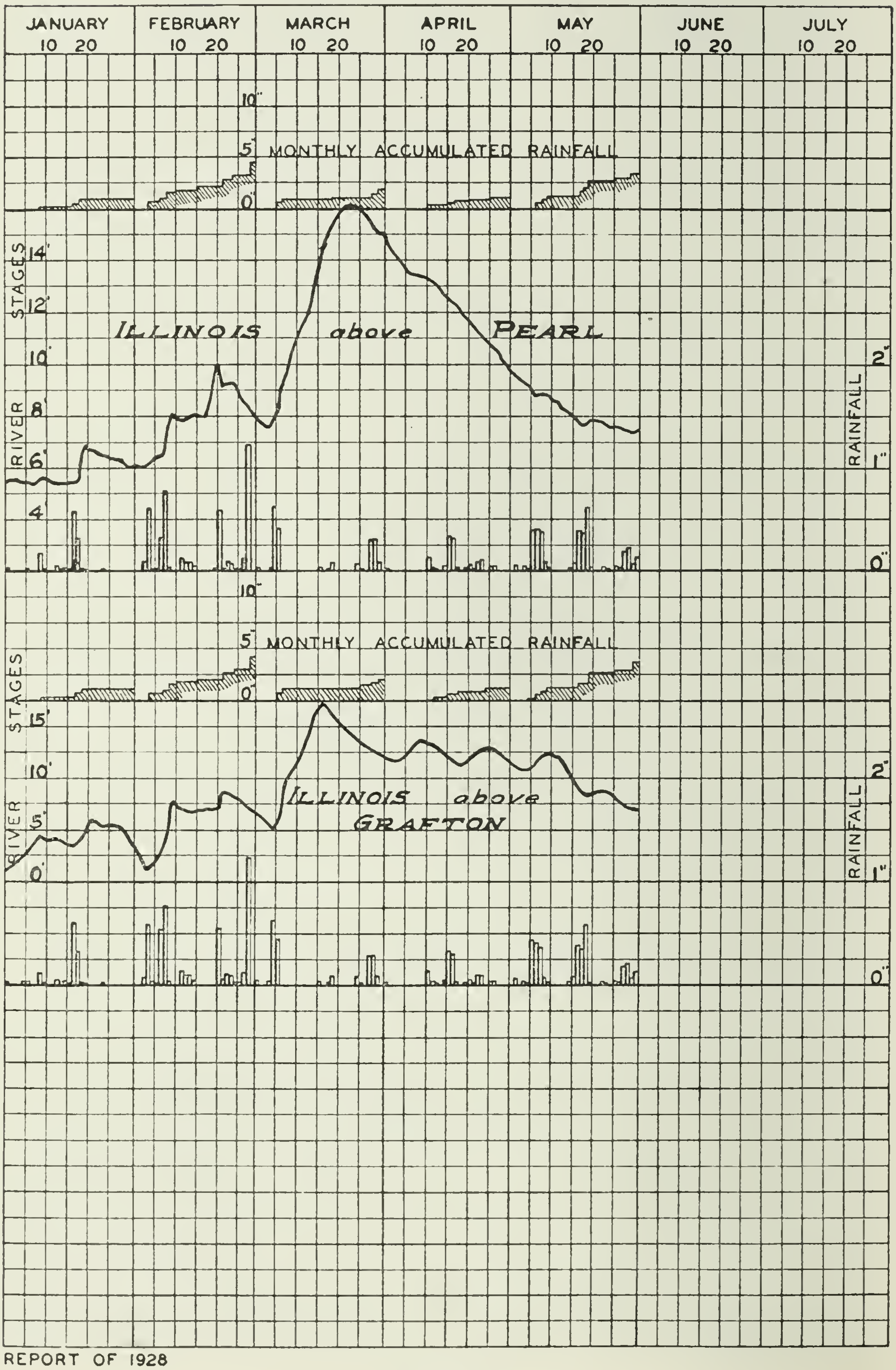

FIGURE A9

RAINFALL AND RIVER STAGES
JANUARY 1904—APRIL 1904, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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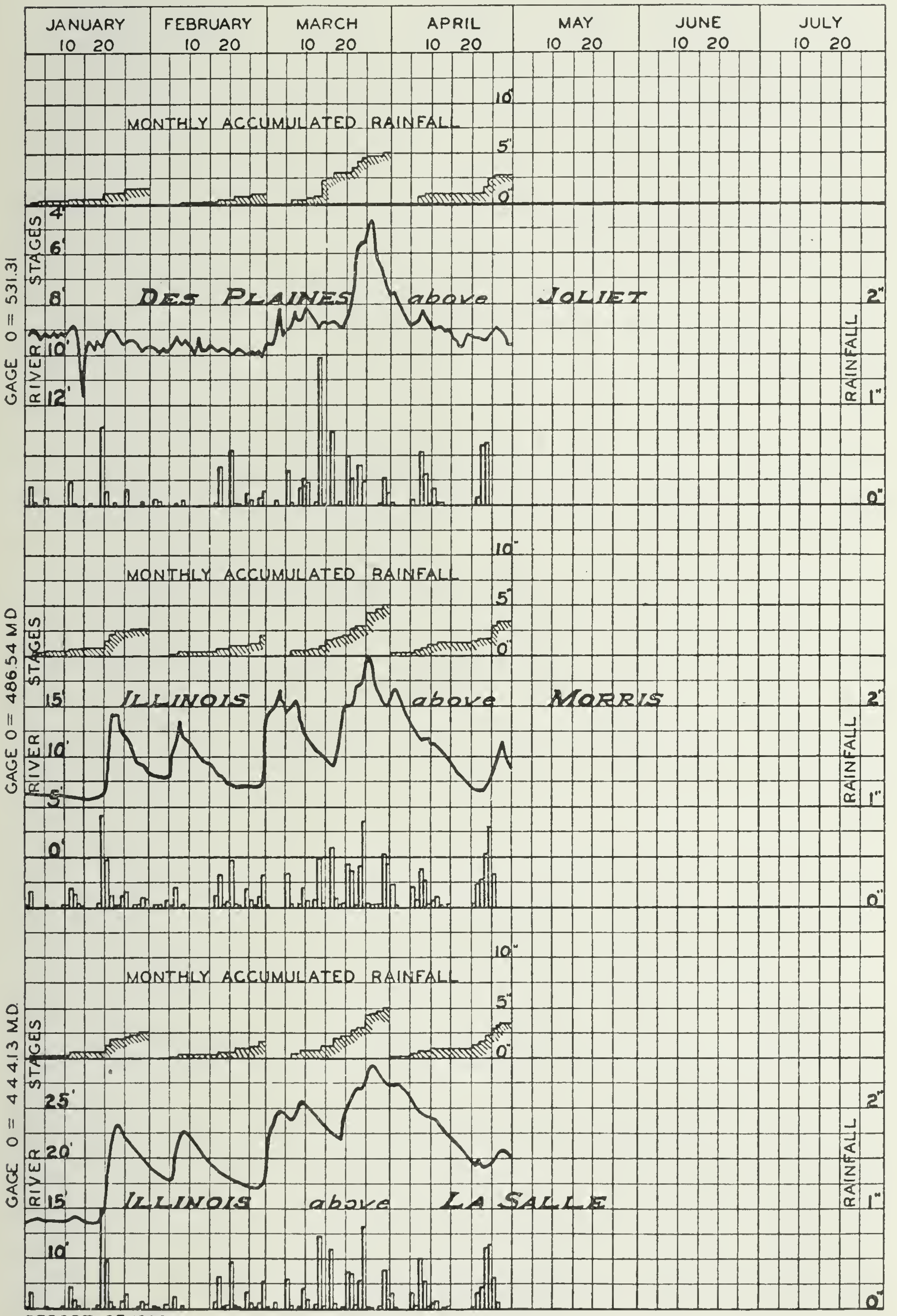

FIGURE A 10

RAINFALL AND RIVER STAGES
JANUARY 1904—APRIL 1904, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
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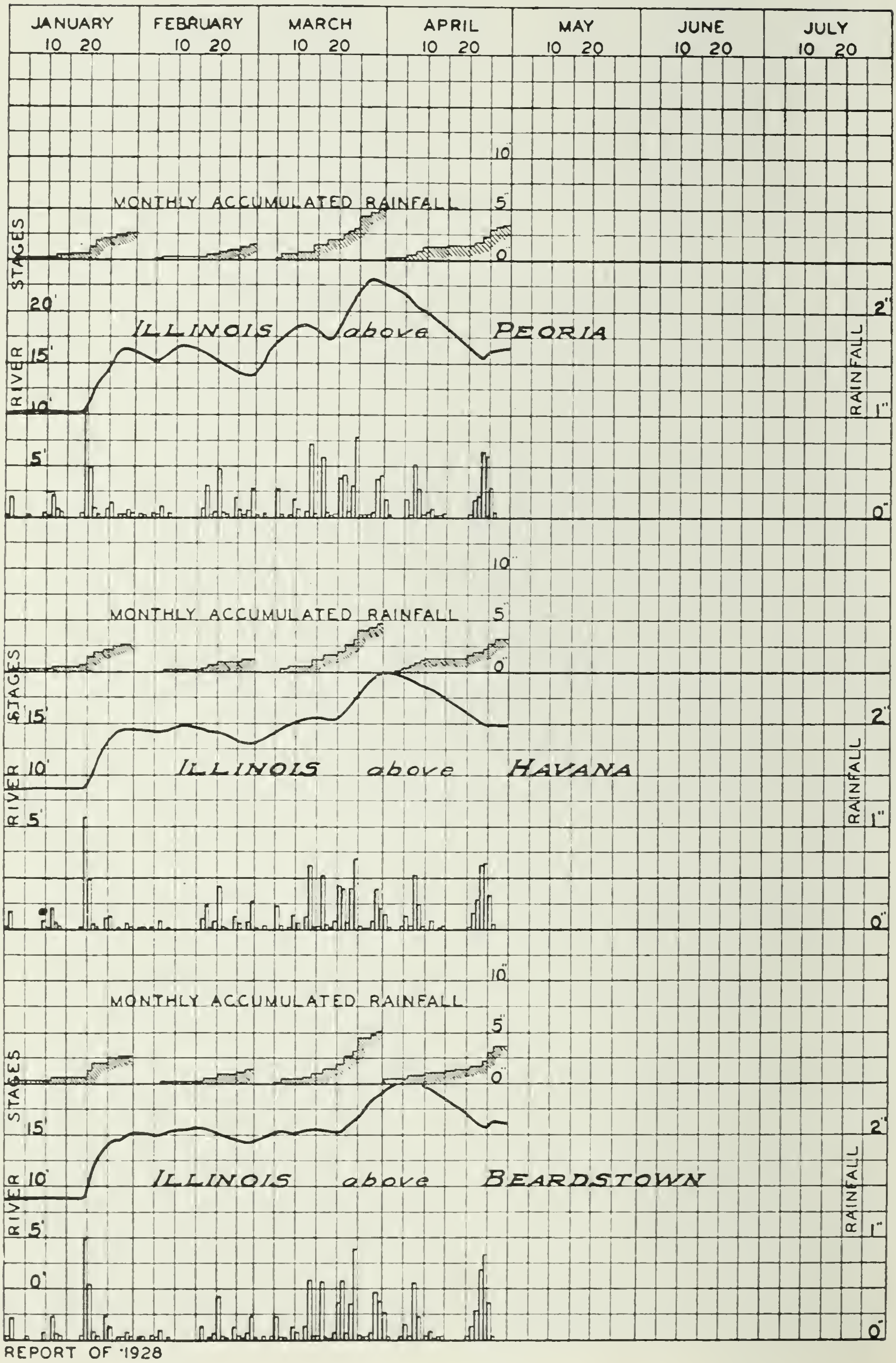

FIGURE A11

RAINFALL AND RIVER STAGES
JANUARY 1904—APRIL 1904, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
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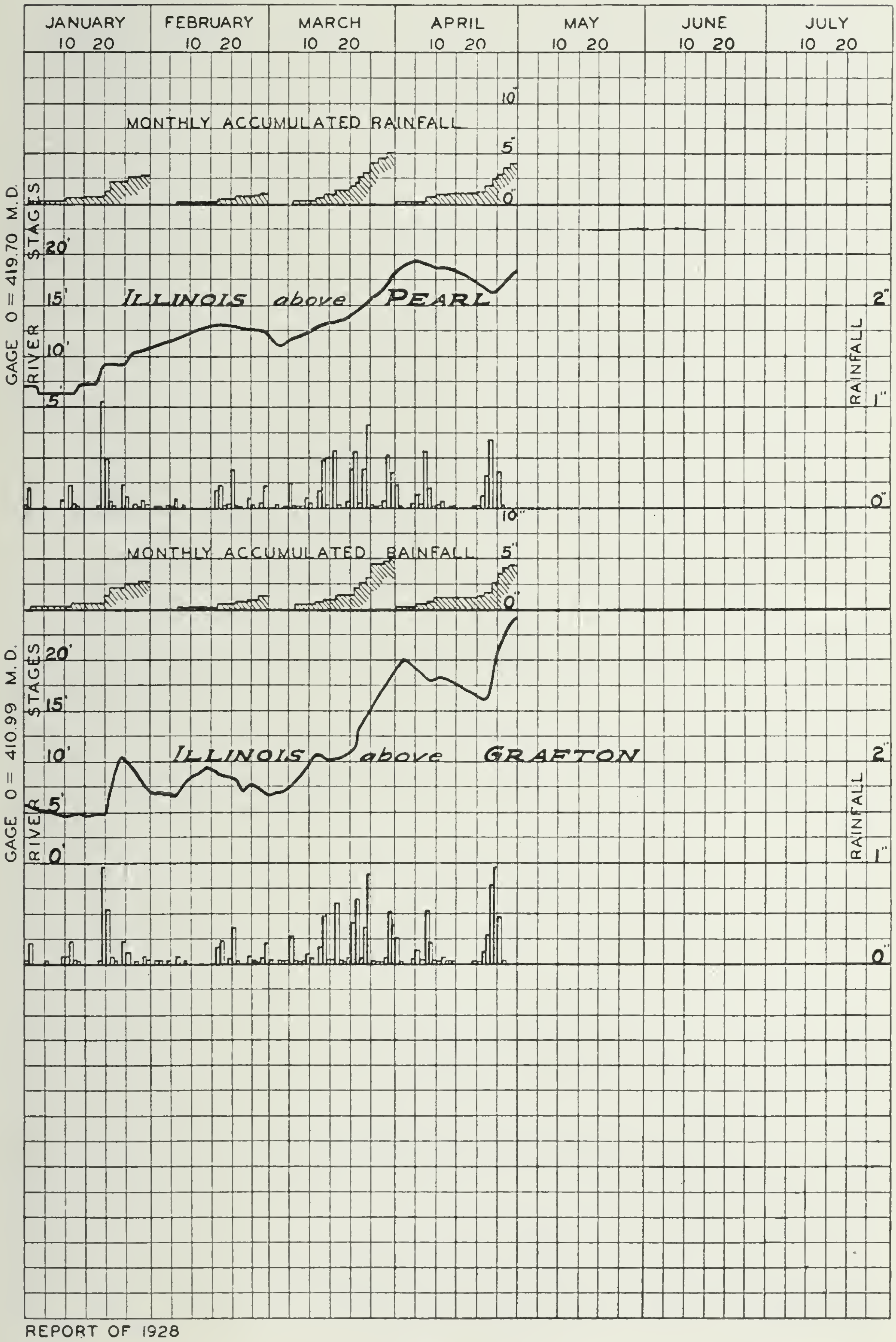

FIGURE A 12

RAINFALL AND RIVER STAGES
JANUARY 1913—APRIL 1913, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

FIGURE A 13

RAINFALL AND RIVER STAGES
JANUARY 1913—APRIL 1913, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

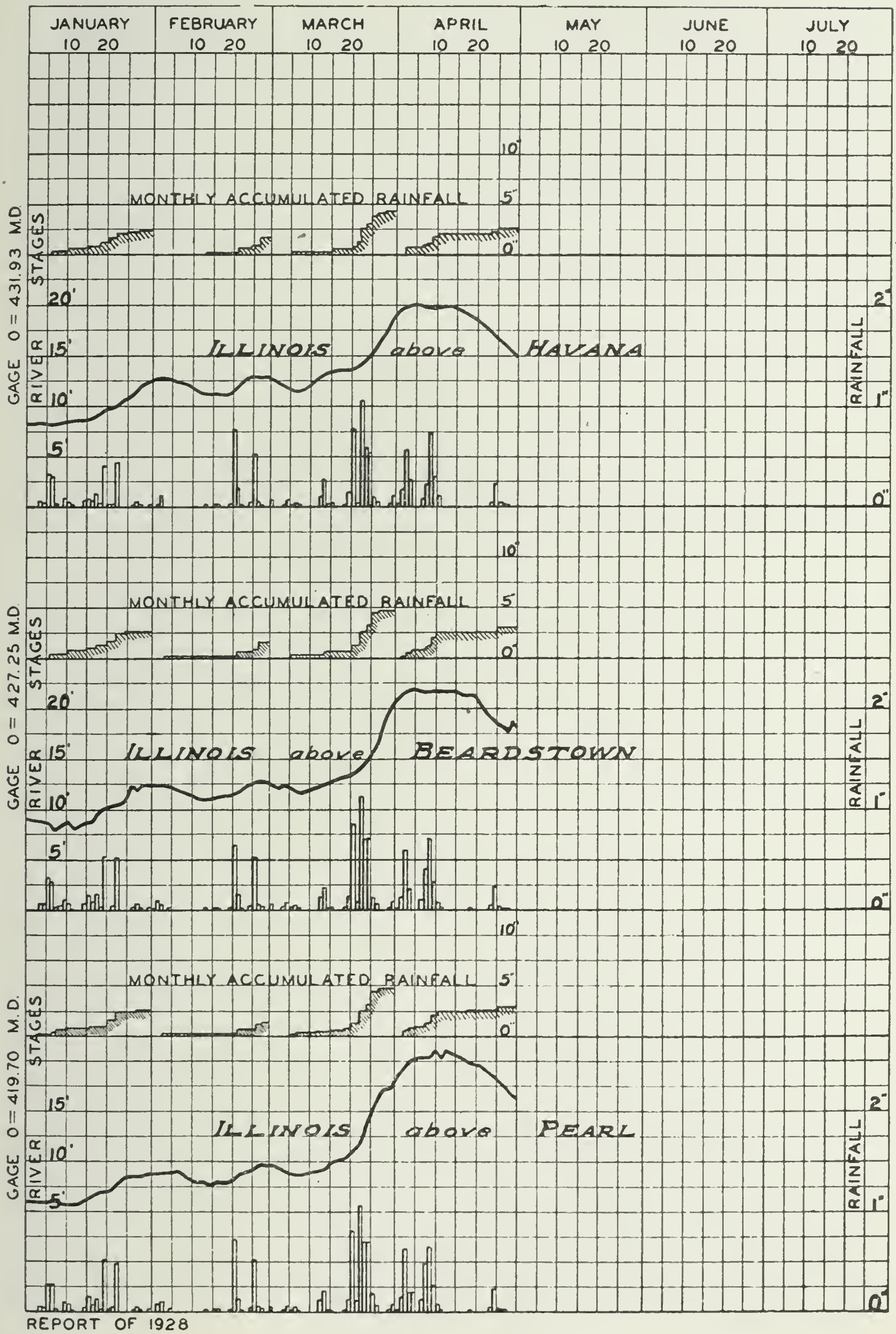

FIGURE A 14

RAINFALL AND RIVER STAGES
JANUARY 1913—APRIL 1913, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
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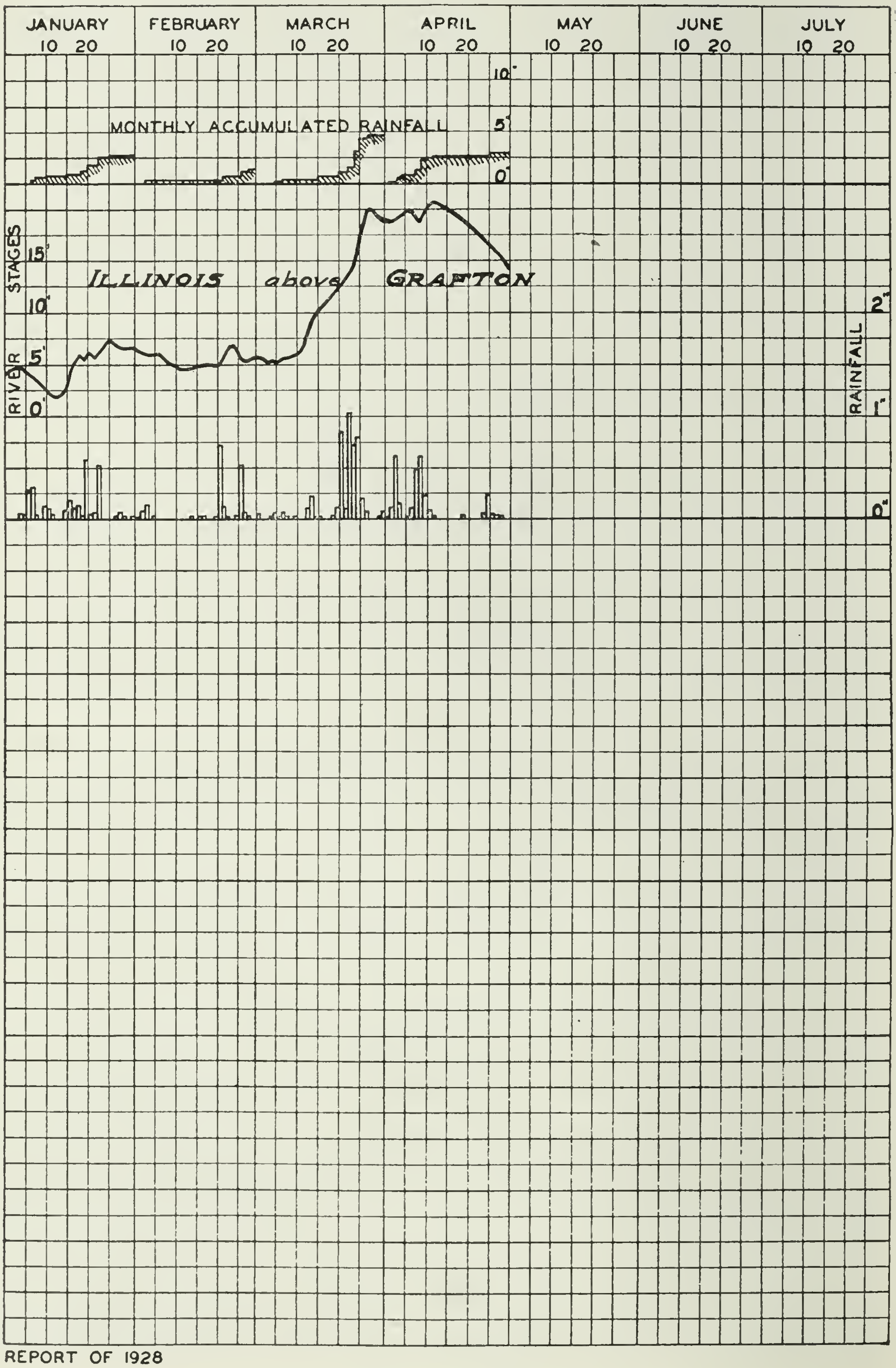

FIGURE A 15

RAINFALL AND RIVER STAGES
DECEMBER 1915—FEBRUARY 1916, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

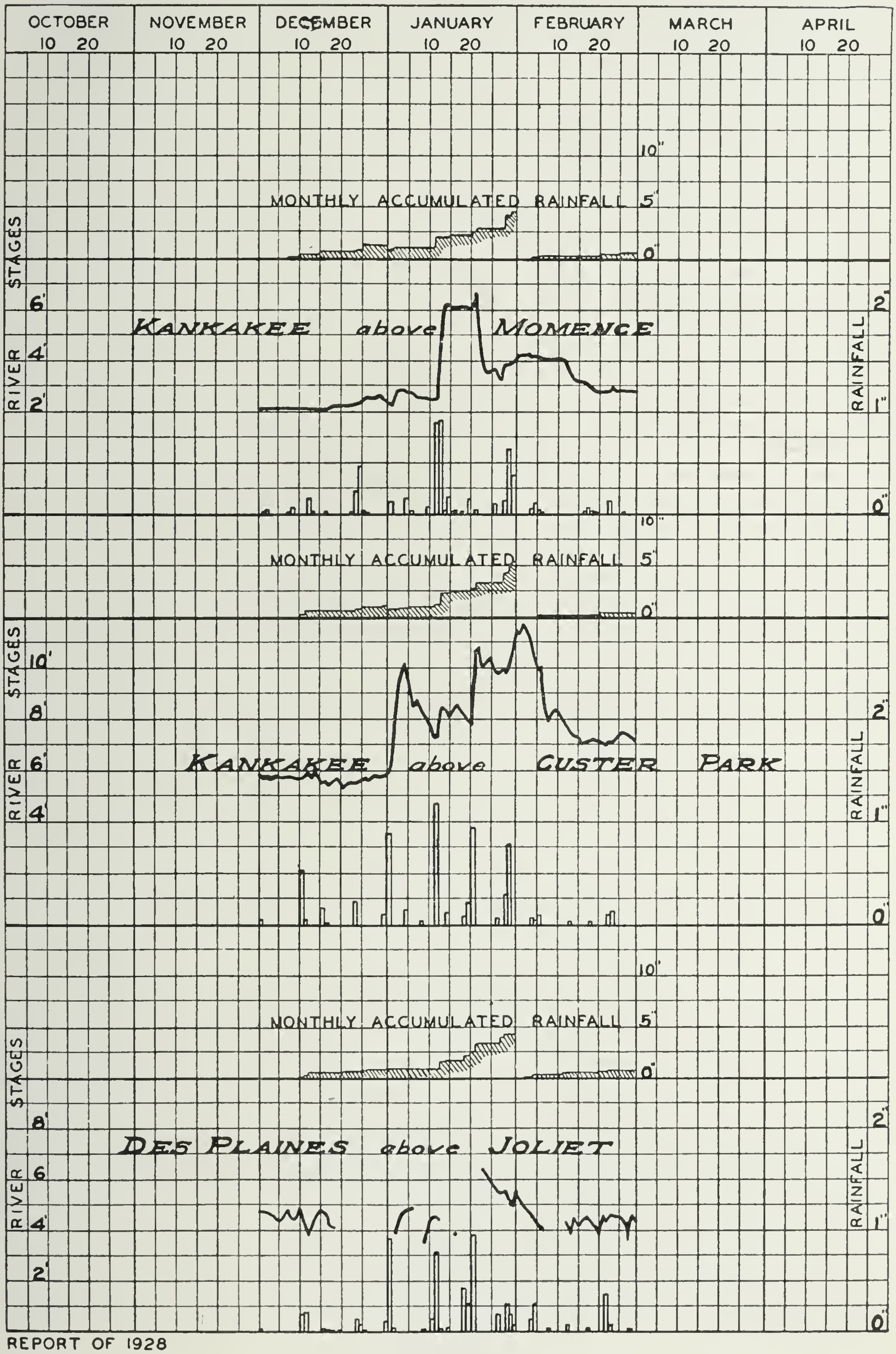

FIGURE A 16

RAINFALL AND RIVER STAGES
DECEMBER 1915—FEBRUARY 1916, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
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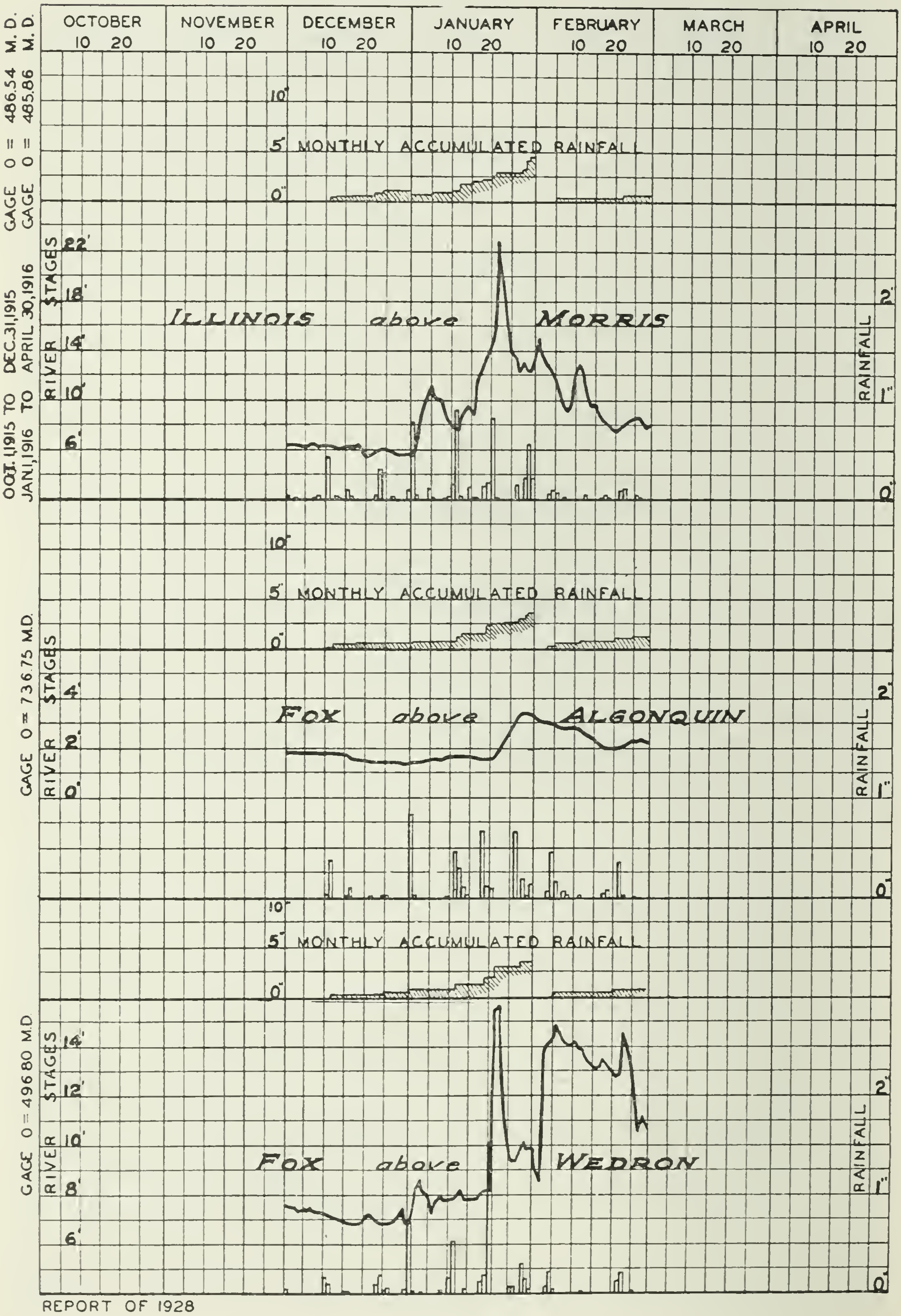

FIGURE A 17

RAINFALL AND RIVER STAGES
DECEMBER 1915—FEBRUARY 1916, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

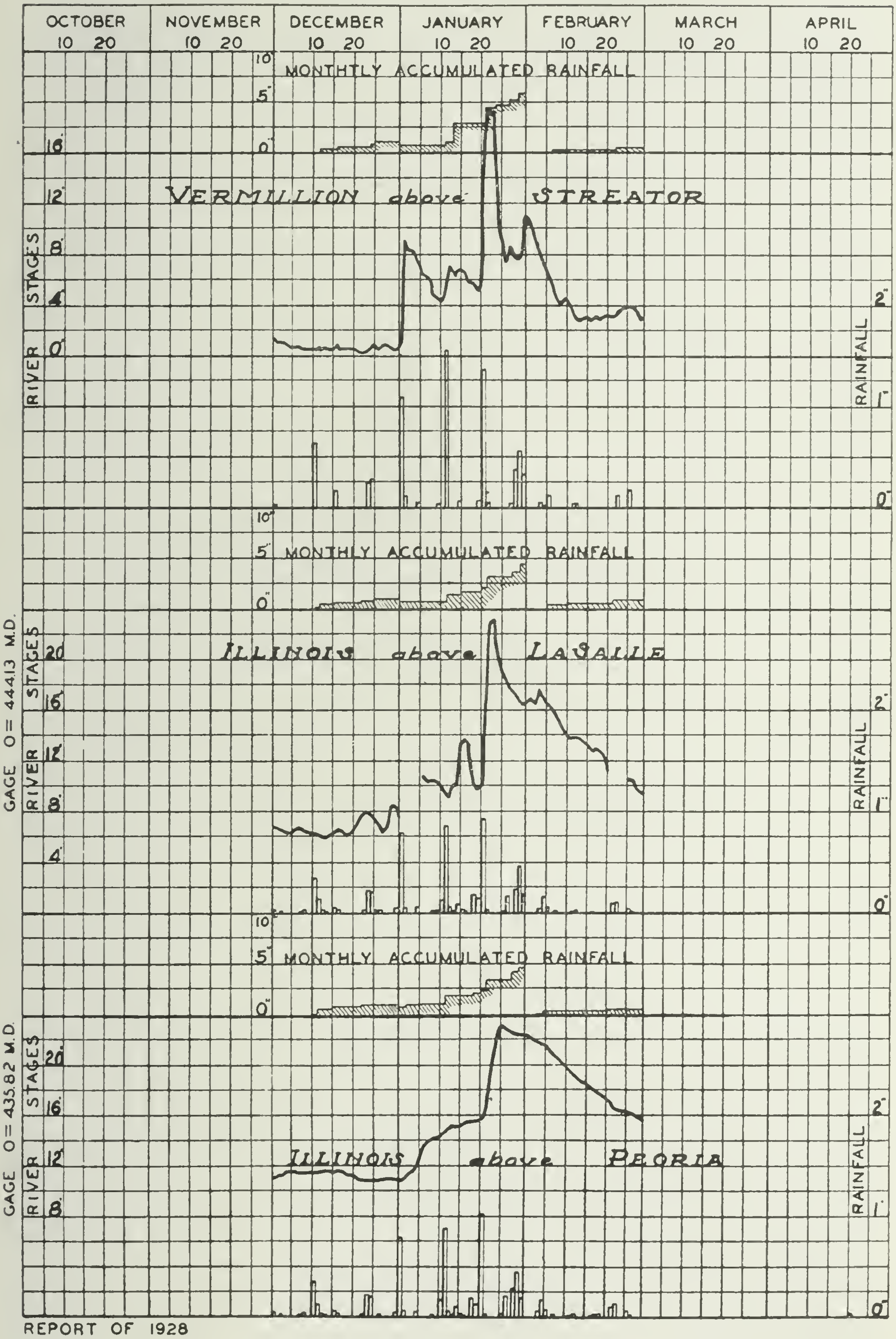

FIGURE A 18

RAINFALL AND RIVER STAGES
December 1915—February 1916, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

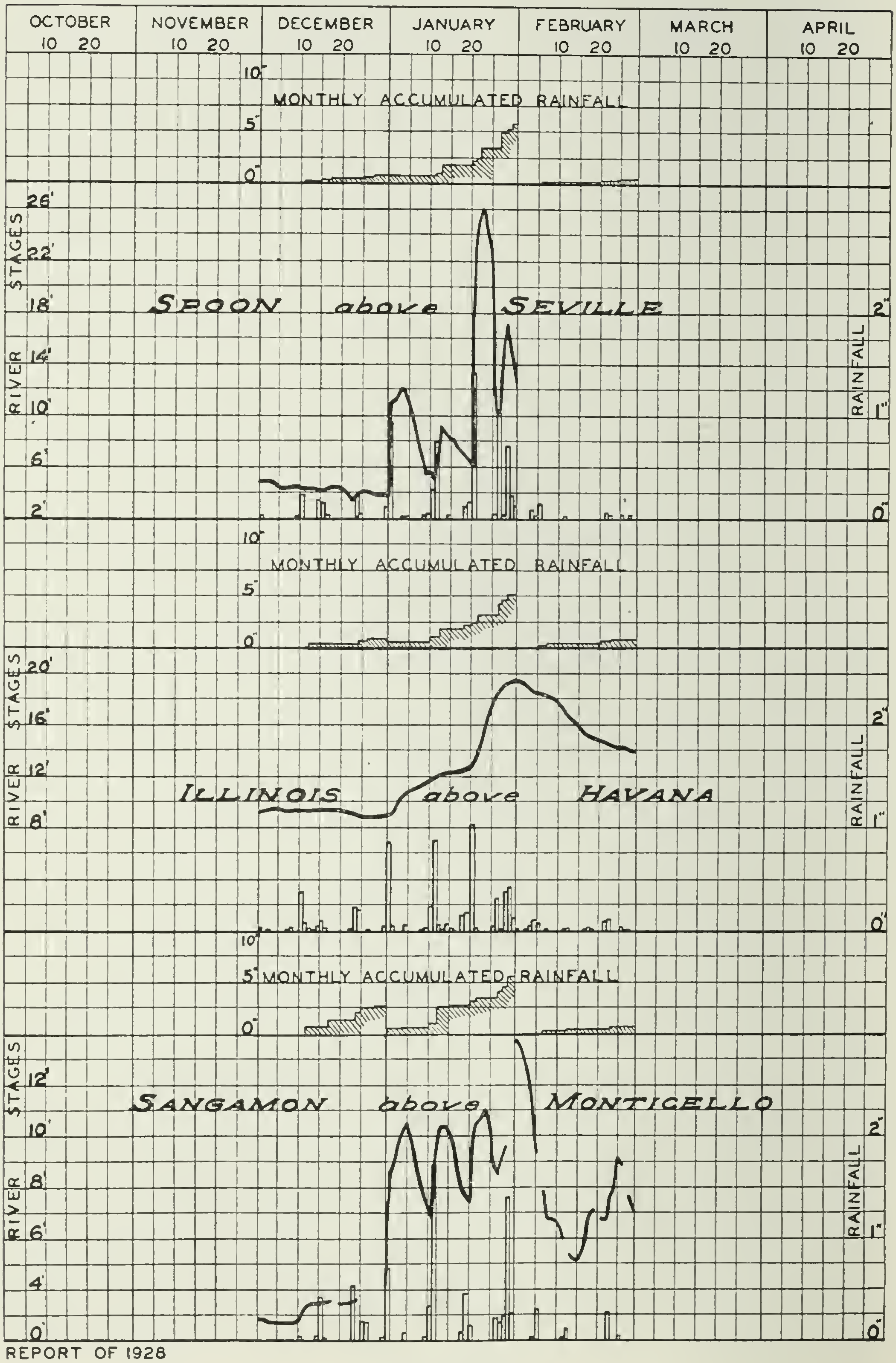

FIGURE A 19

RAINFALL AND RIVER STAGES
DECEMBER 1915—FEBRUARY 1916, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

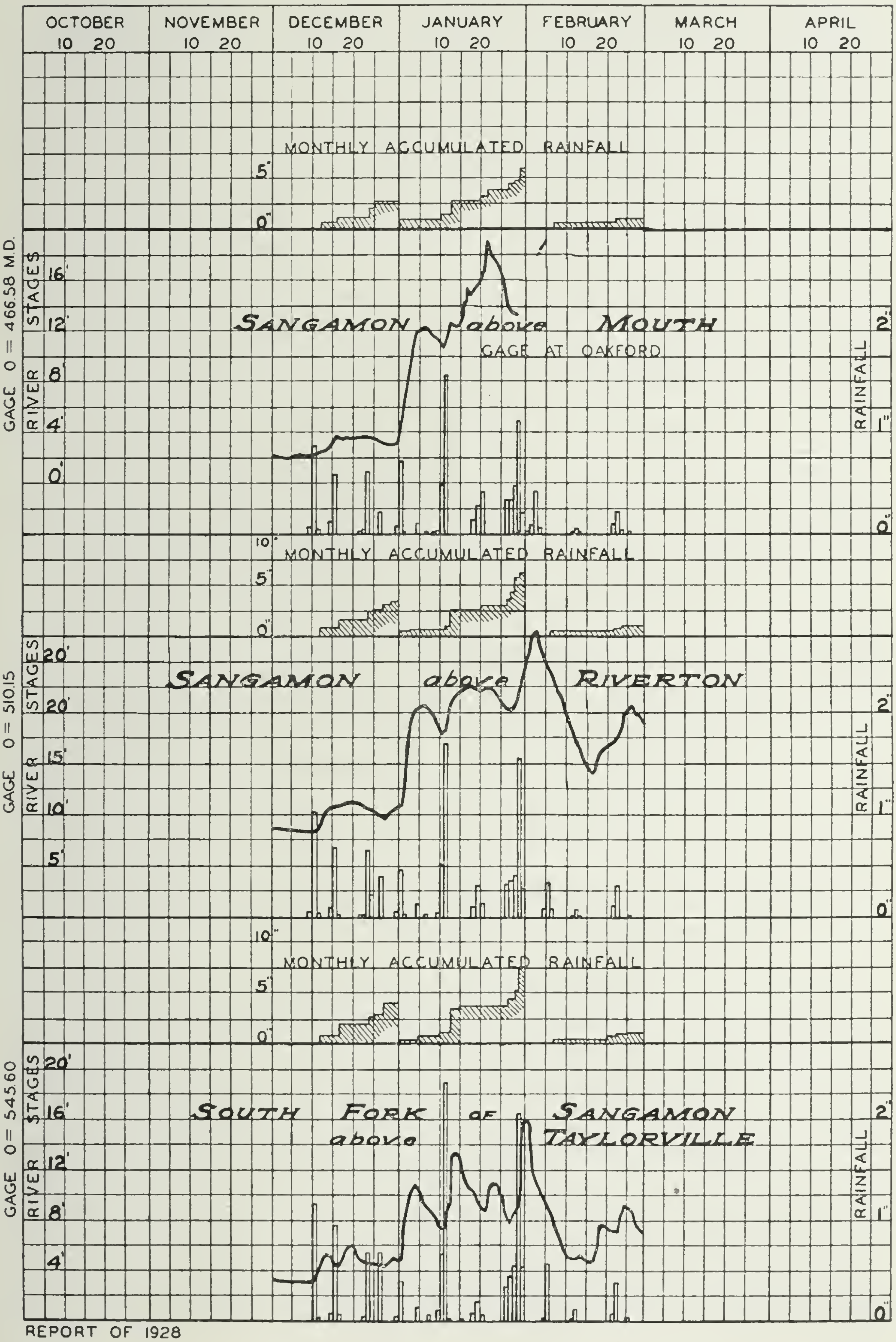

FIGURE A 20

RAINFALL AND RIVER STAGES
December 1915—February 1916, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

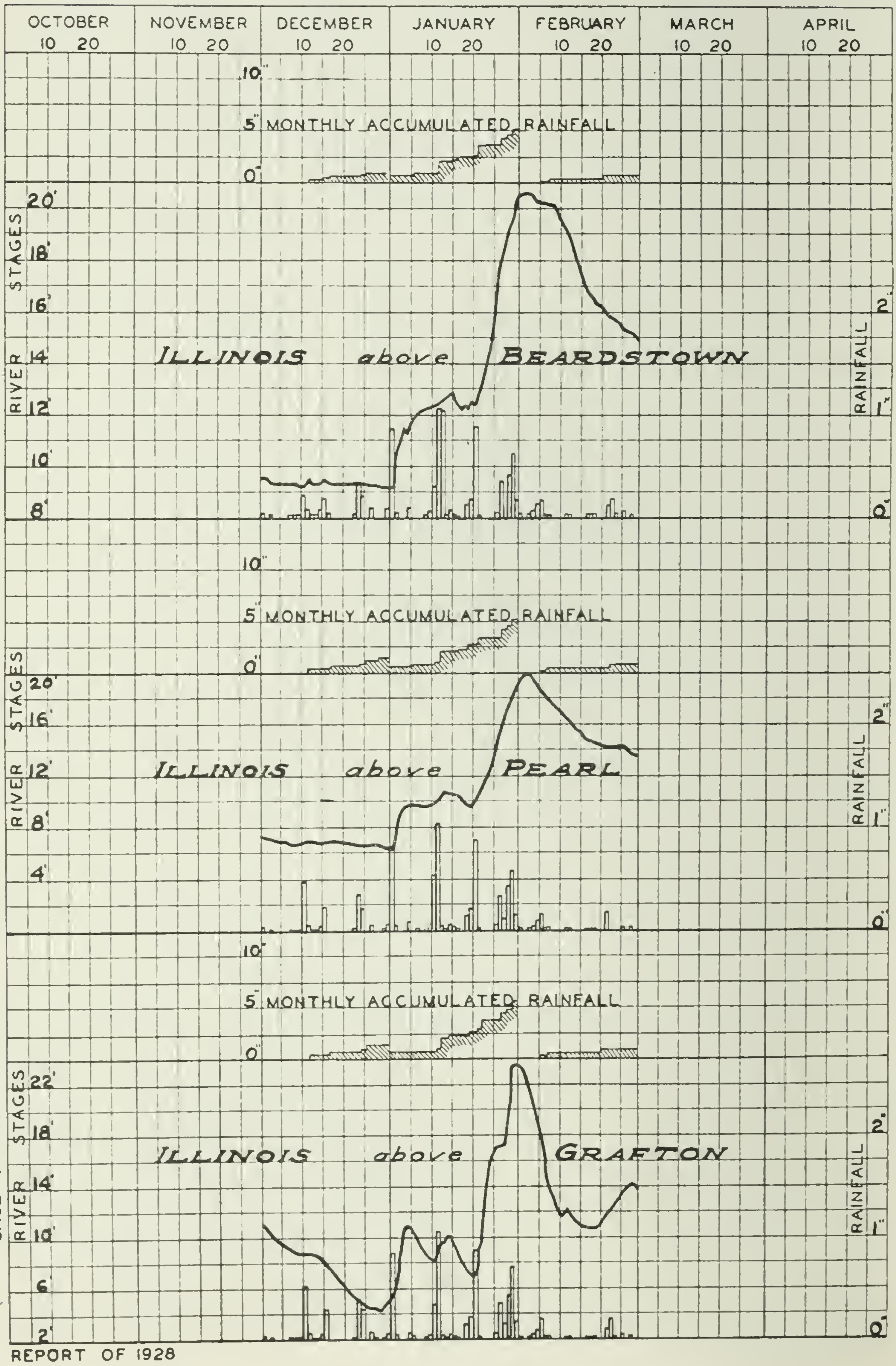

FIGURE A21

RAINFALL AND RIVER STAGES
October 1921—April 1922, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

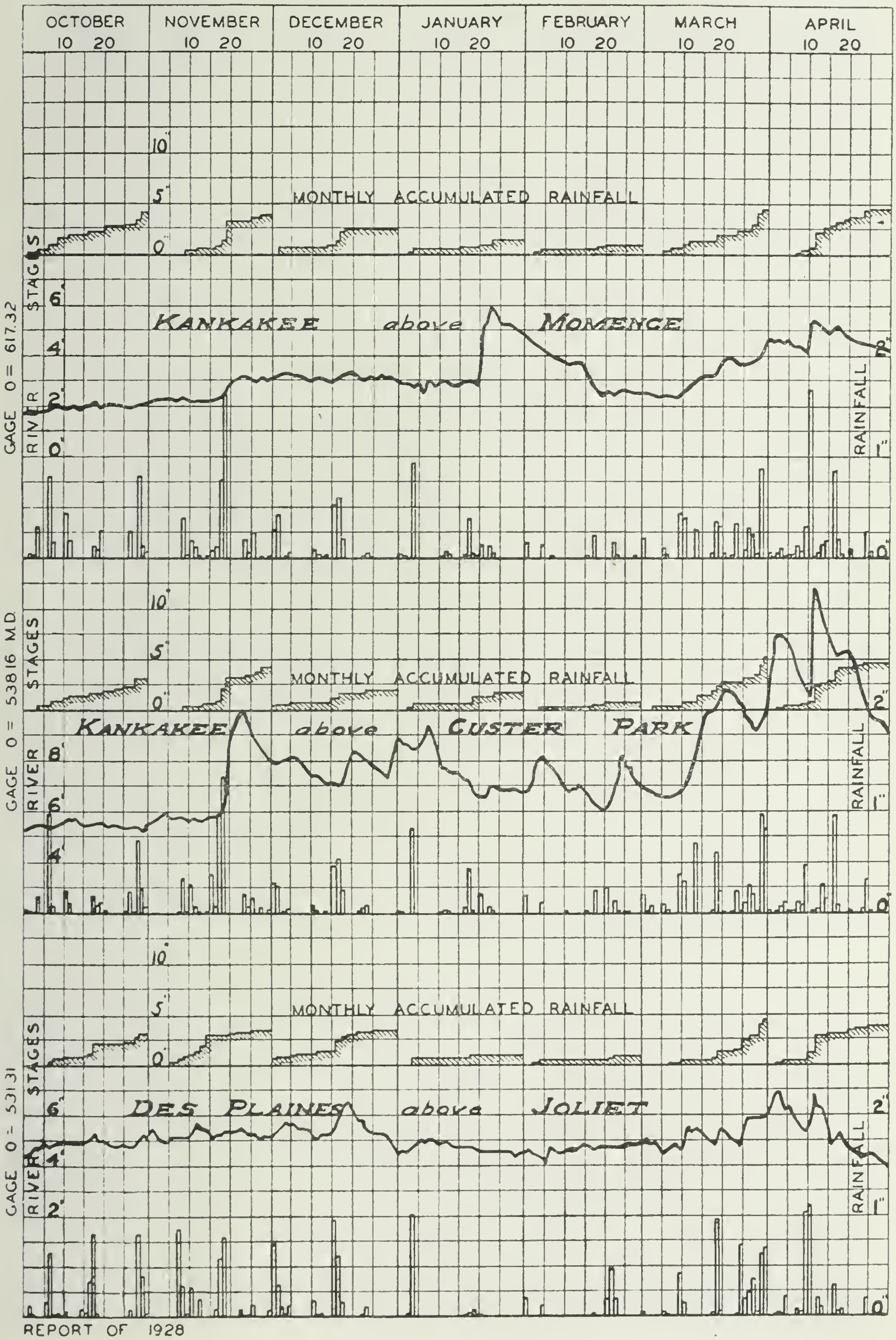

FIGURE A 22

RAINFALL AND RIVER STAGES
OCTOBER 1921—APRIL 1922, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

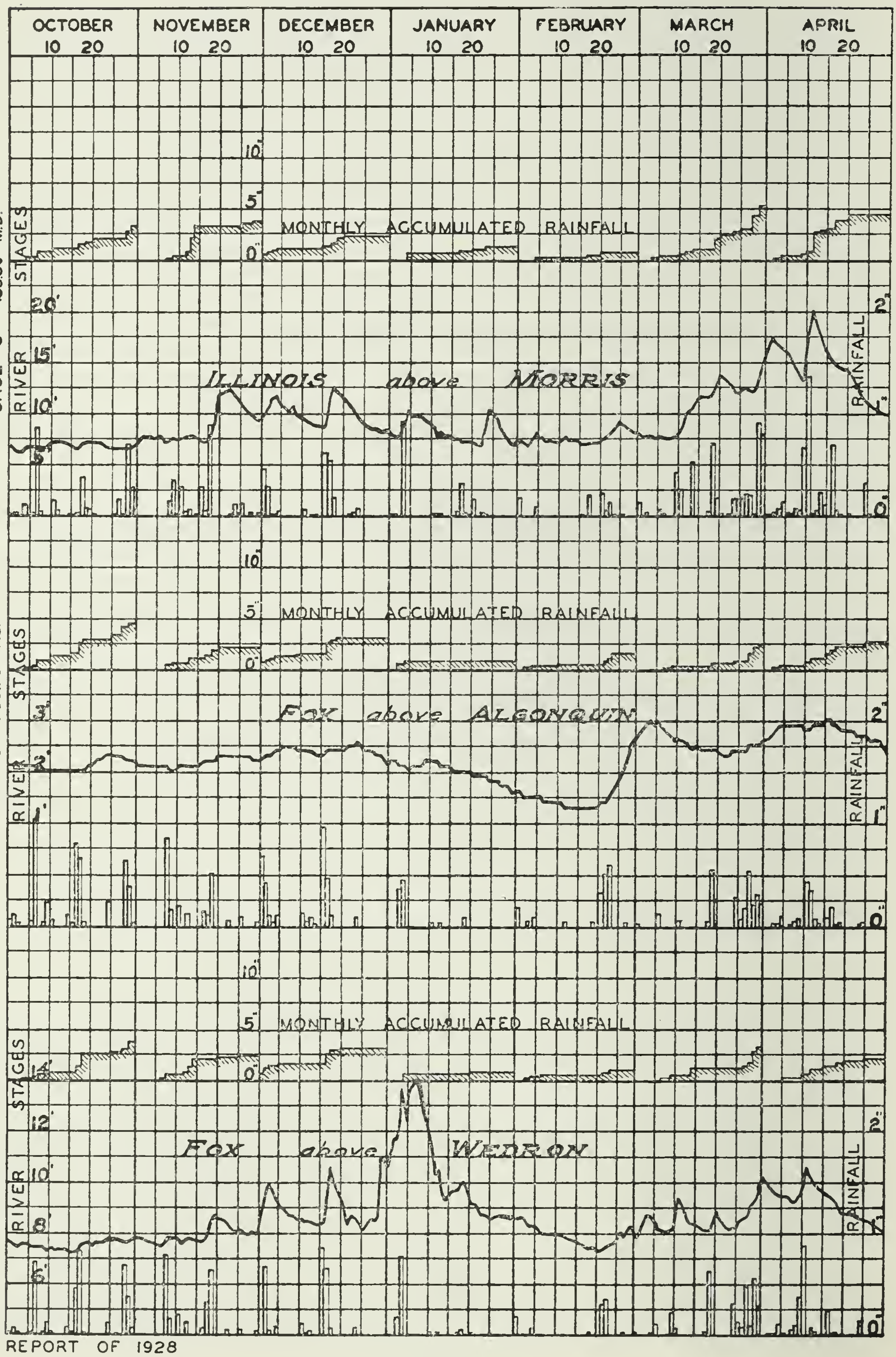

FIGURE A23

RAINFALL AND RIVER STAGES
OCTOBER 1921—APRIL 1922, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

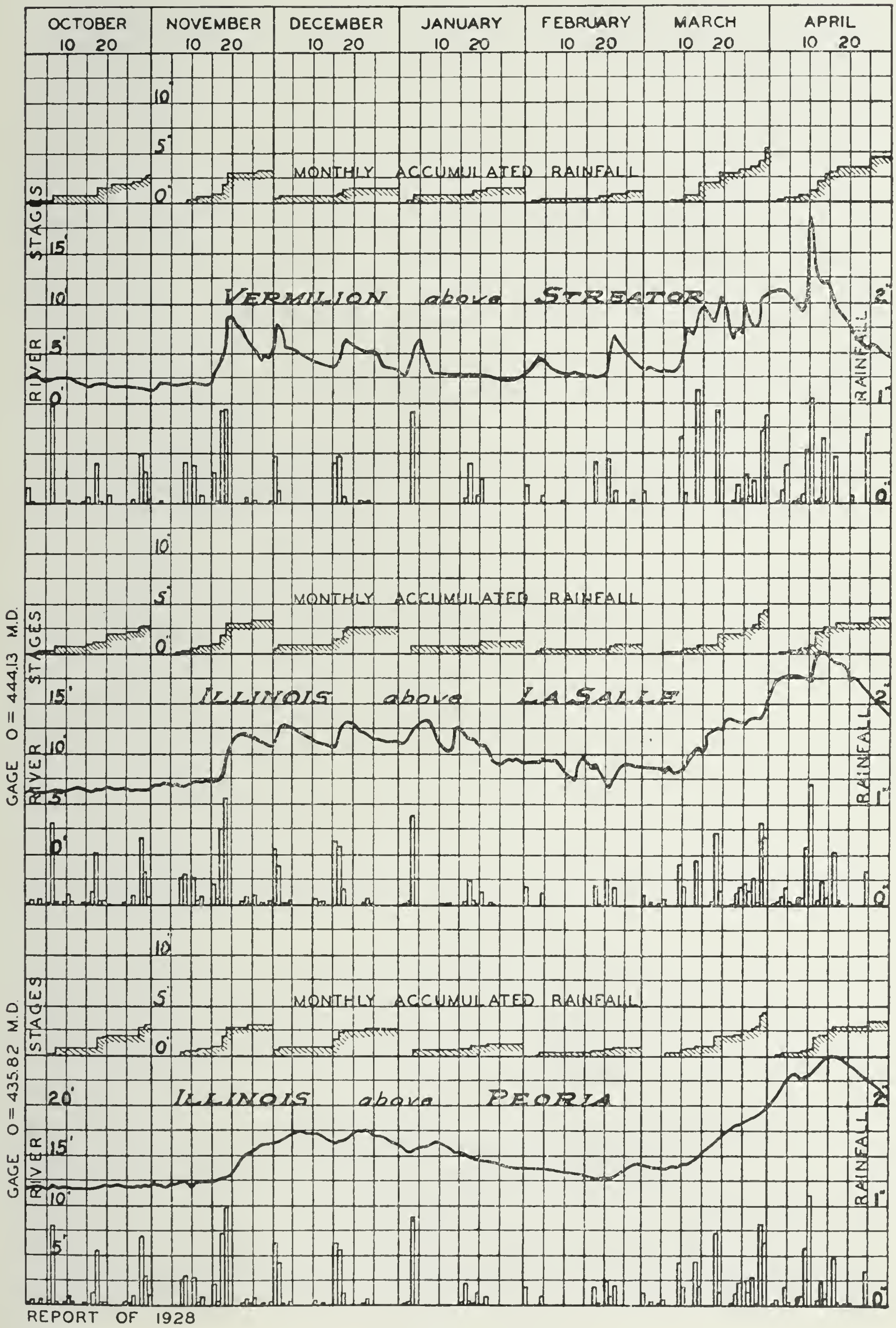

FIGURE A24

RAINFALL AND RIVER STAGES
October 1921—April 1922, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

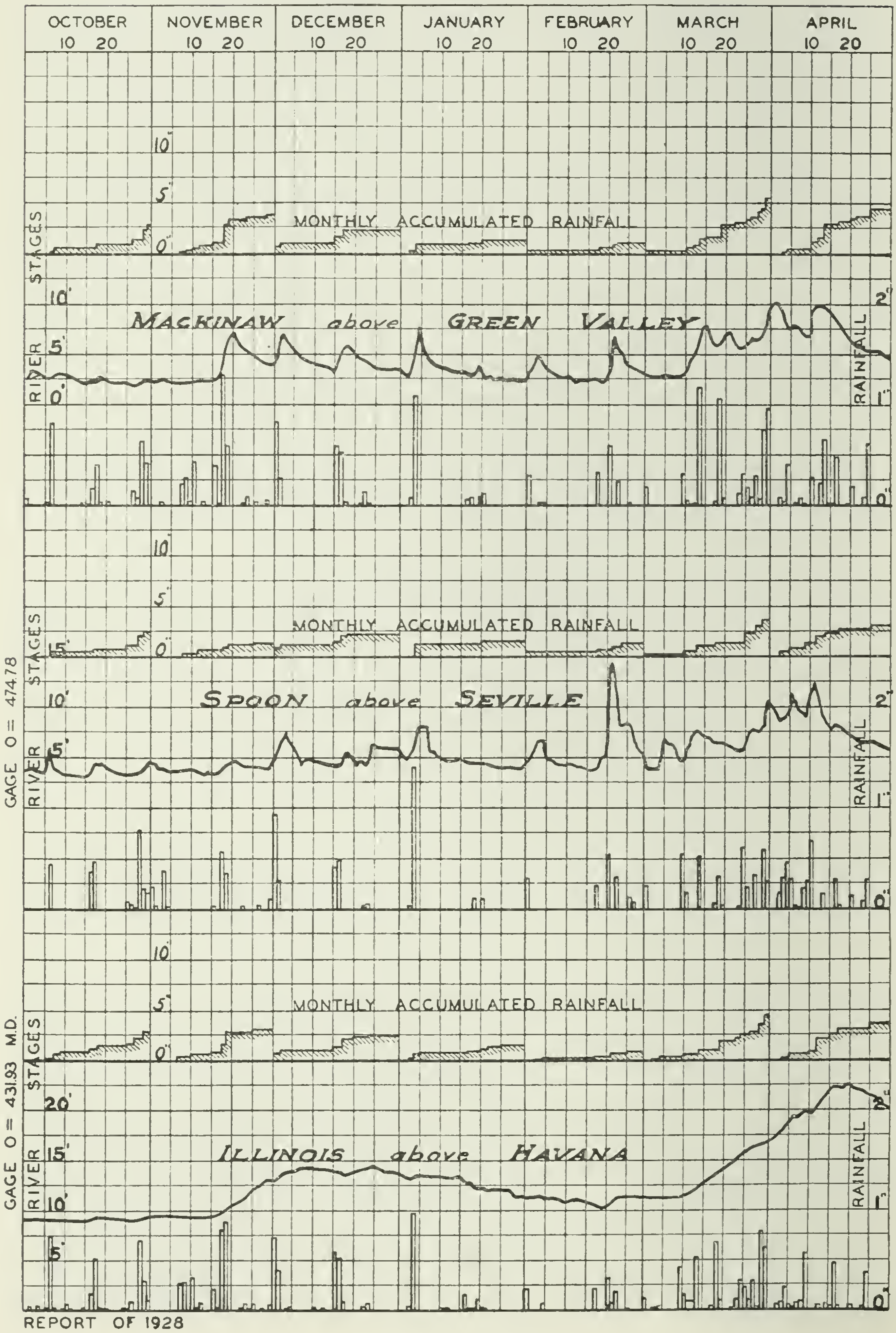

FIGURE A 25

RAINFALL AND RIVER STAGES
October 1921—April 1922, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

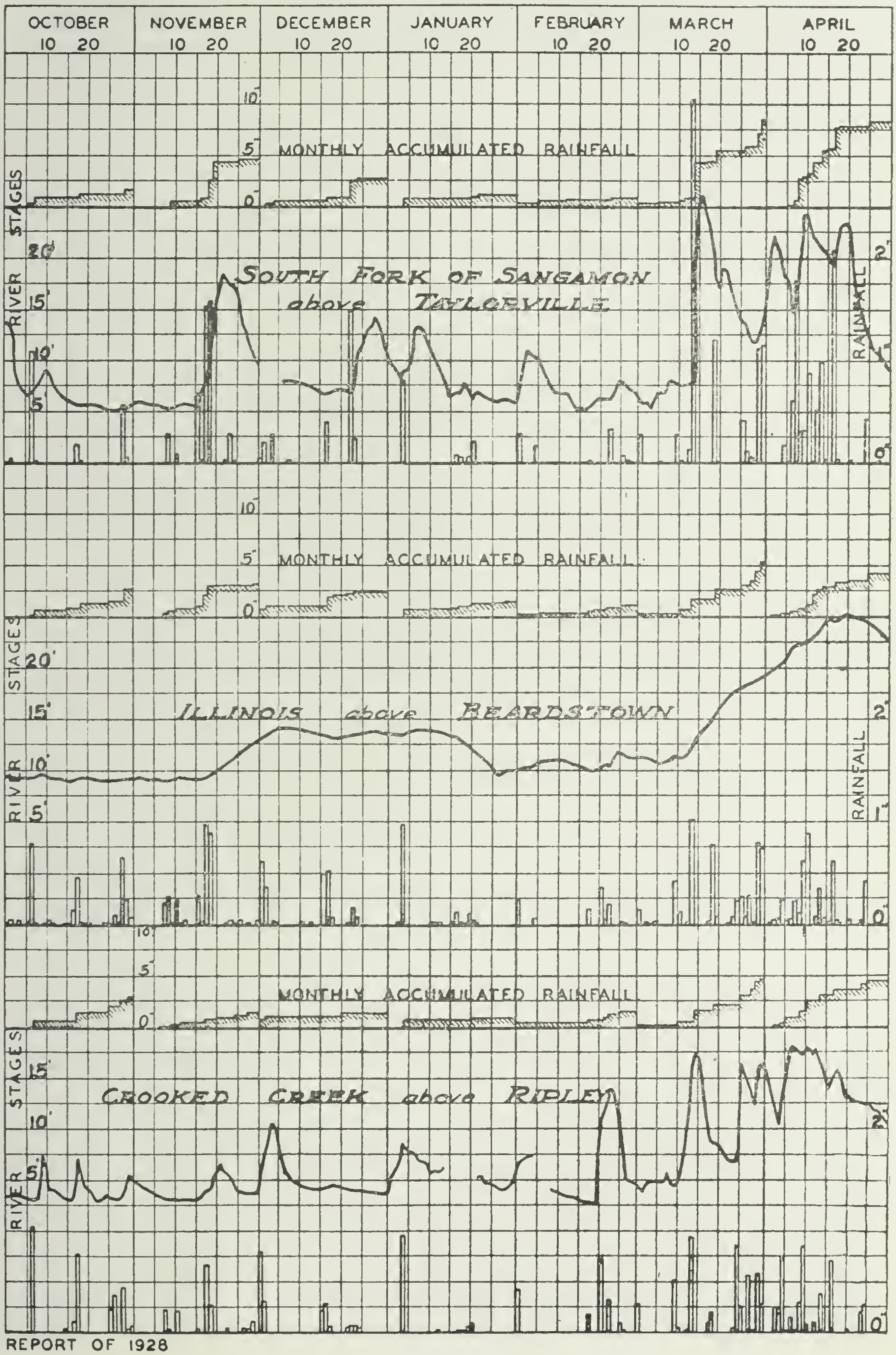

FIGURE A 26

RAINFALL AND RIVER STAGES
OCTOBER 1921—APRIL 1922, INCLUSIVE
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

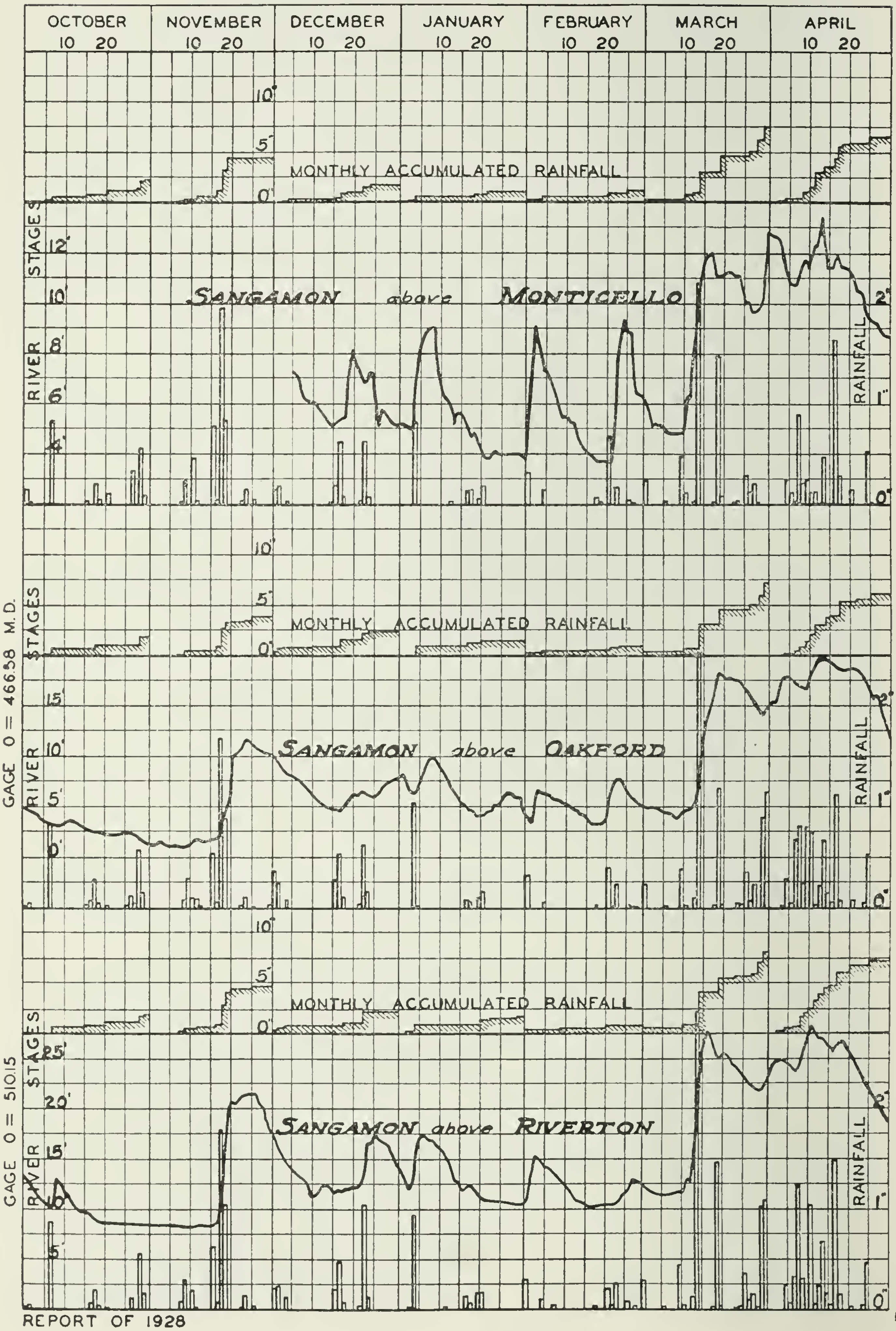

FIGURE A 27

RAINFALL AND RIVER STAGES
October 1921—April 1922, Inclusive
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

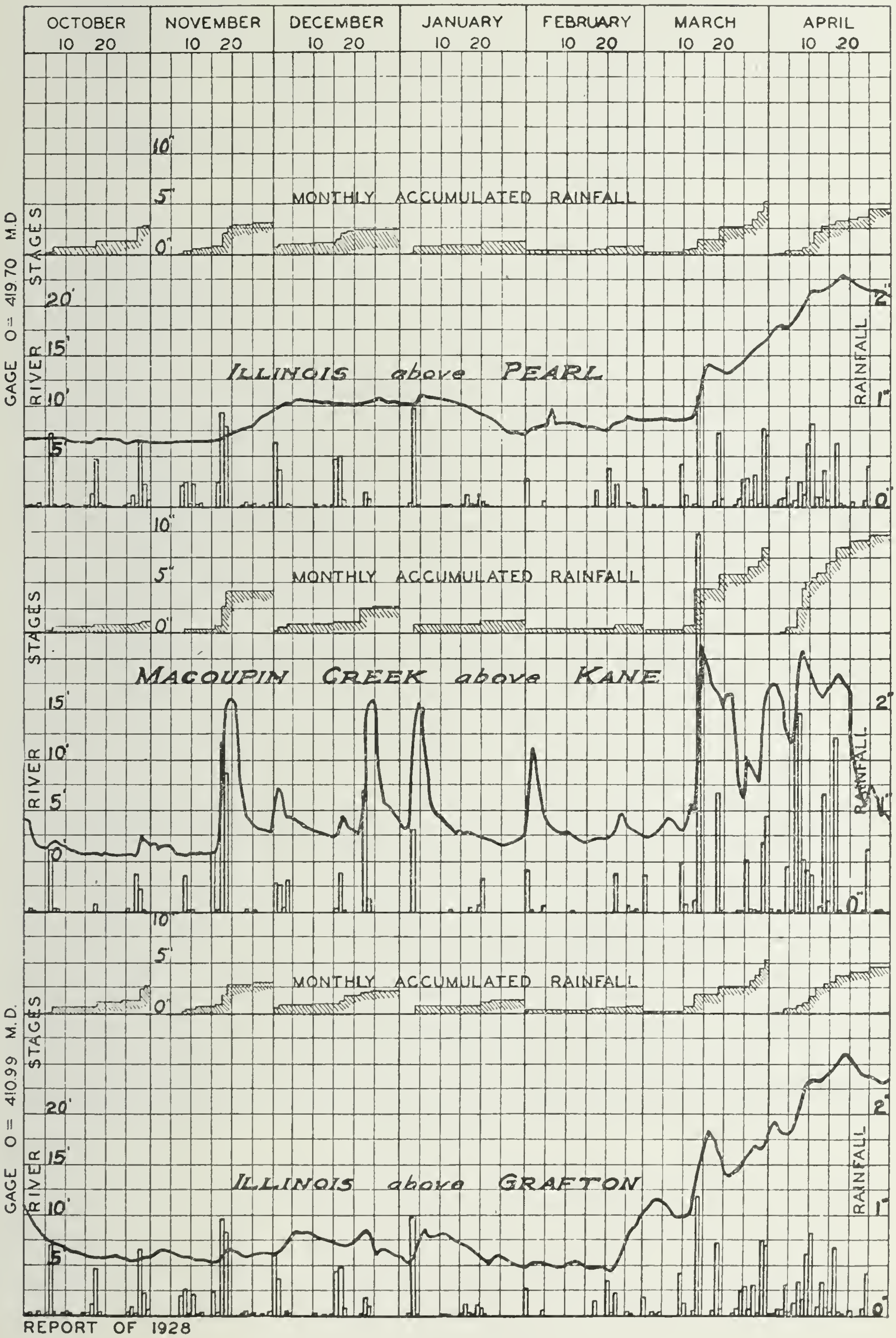

FIGURE A 28

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

FIGURE A 29

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

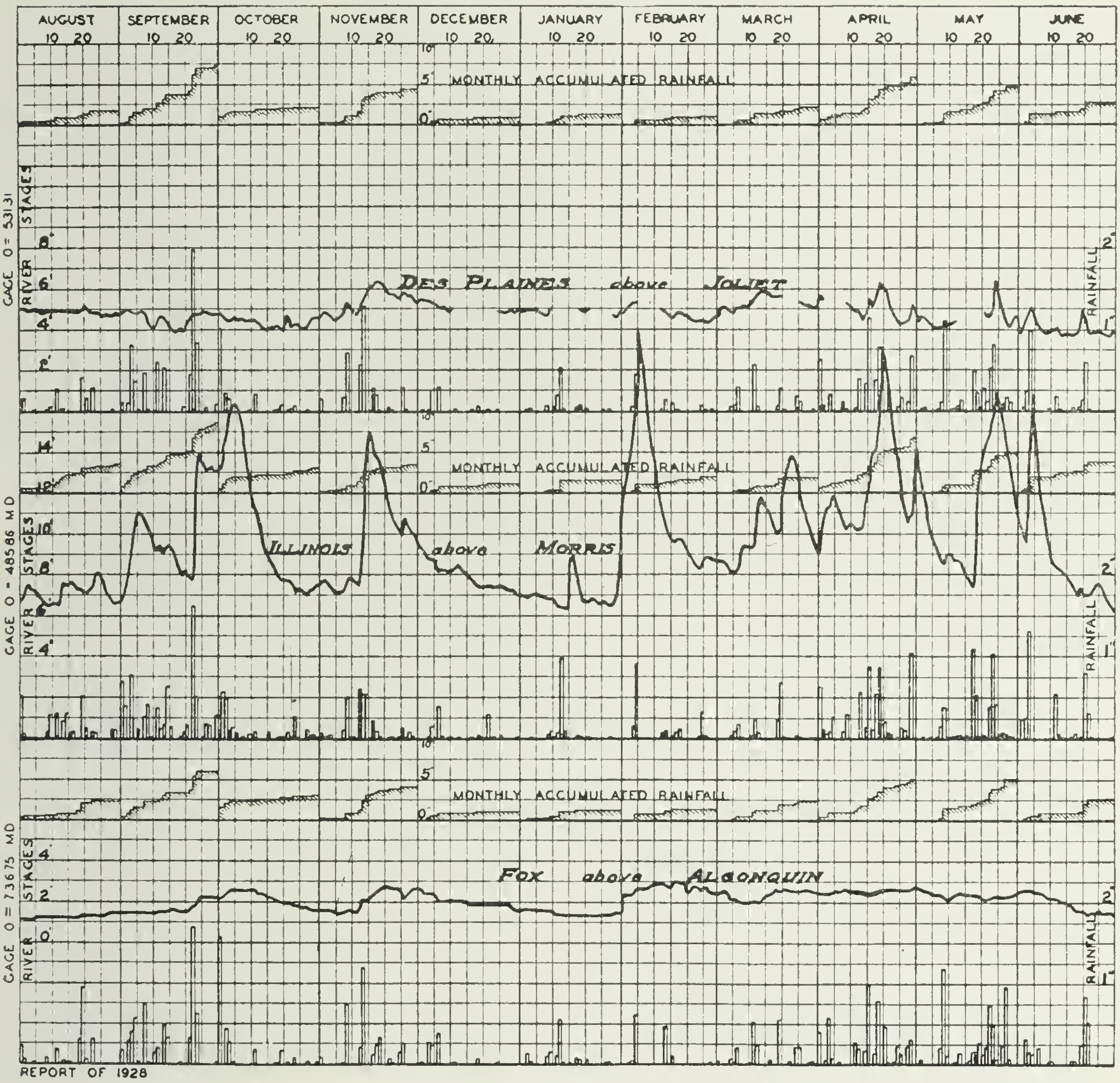

FIGURE A30

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

FIGURE A31

RAINFALL AND RIVER STAGES

August 1926—June 1927, Inclusive

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By Jacob A. Harman, Consulting Engineer

FIGURE A32

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

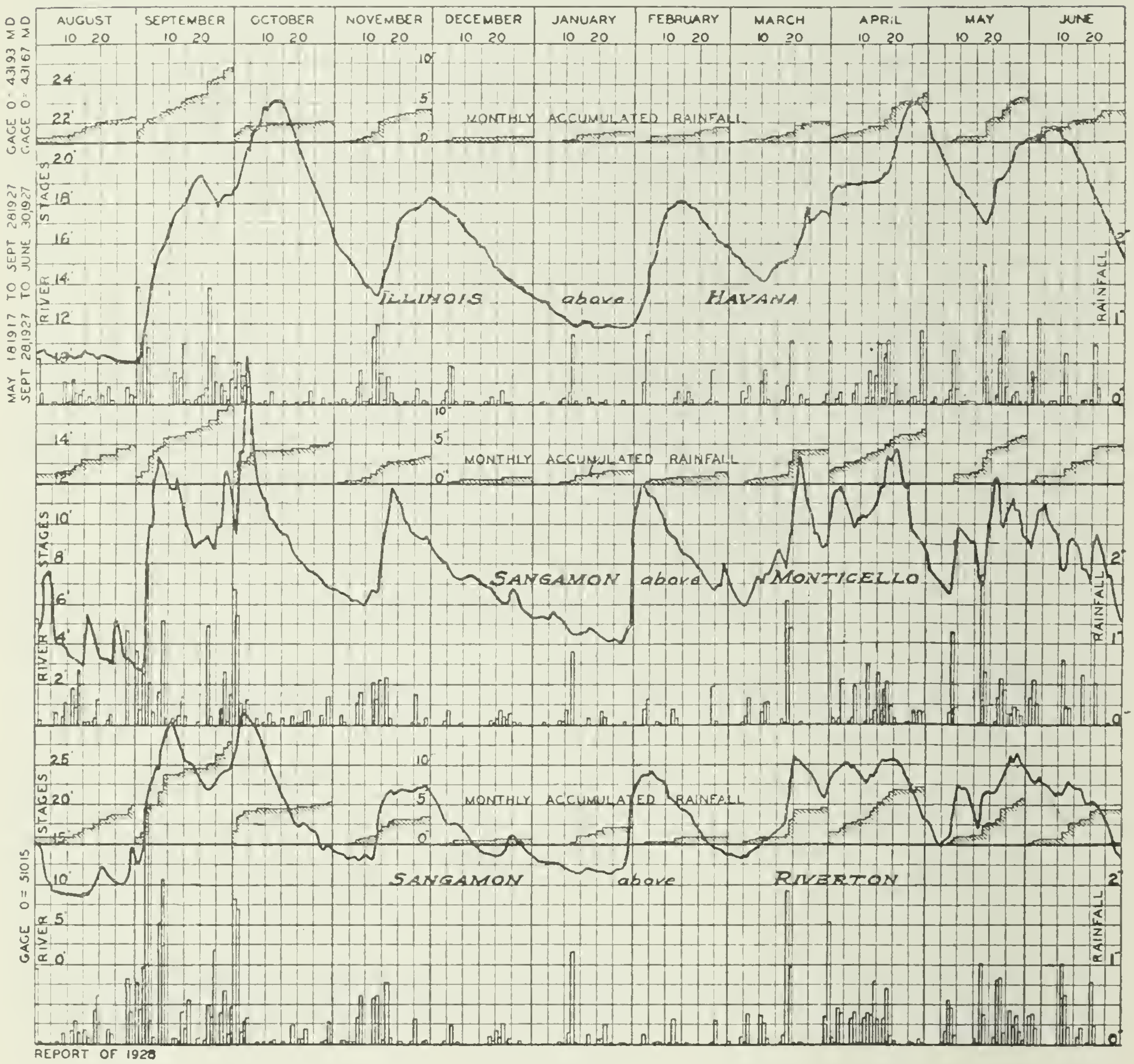

FIGURE A33

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

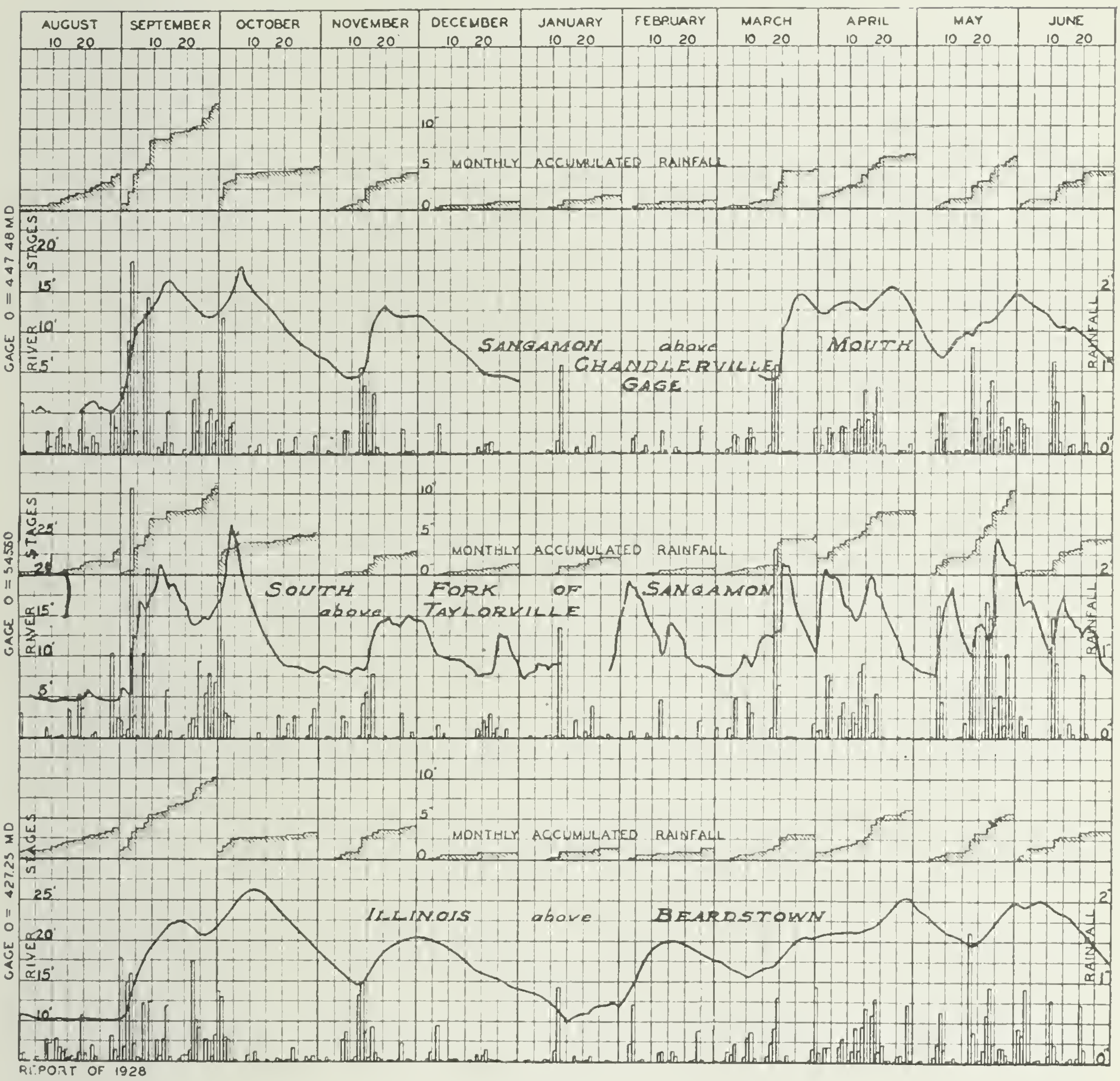

FIGURE A34

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

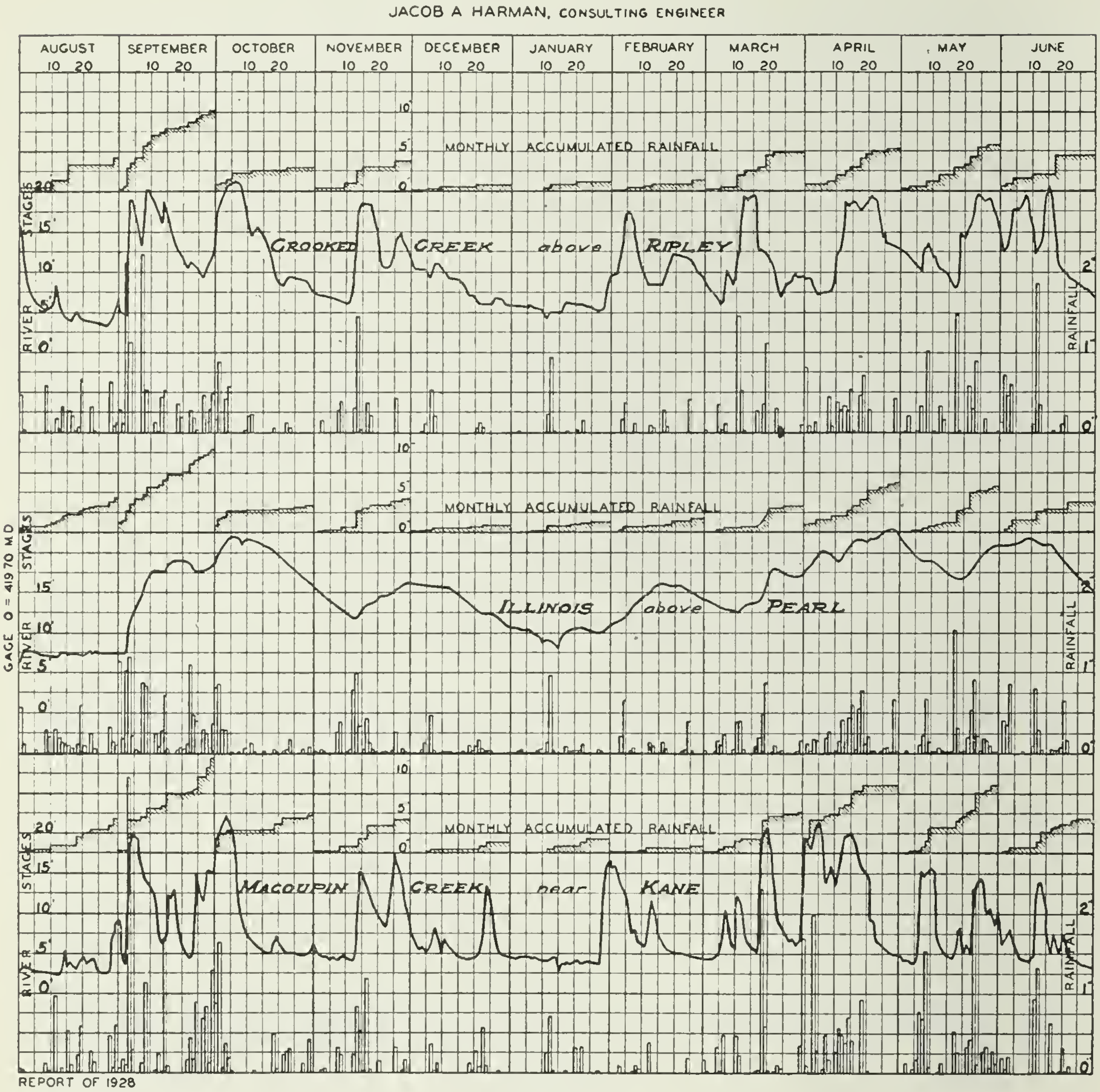

FIGURE A35

RAINFALL AND RIVER STAGES

AUGUST 1926—JUNE 1927, INCLUSIVE

REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER

DIVISION OF WATERWAYS, STATE OF ILLINOIS

By JACOB A. HARMAN, Consulting Engineer

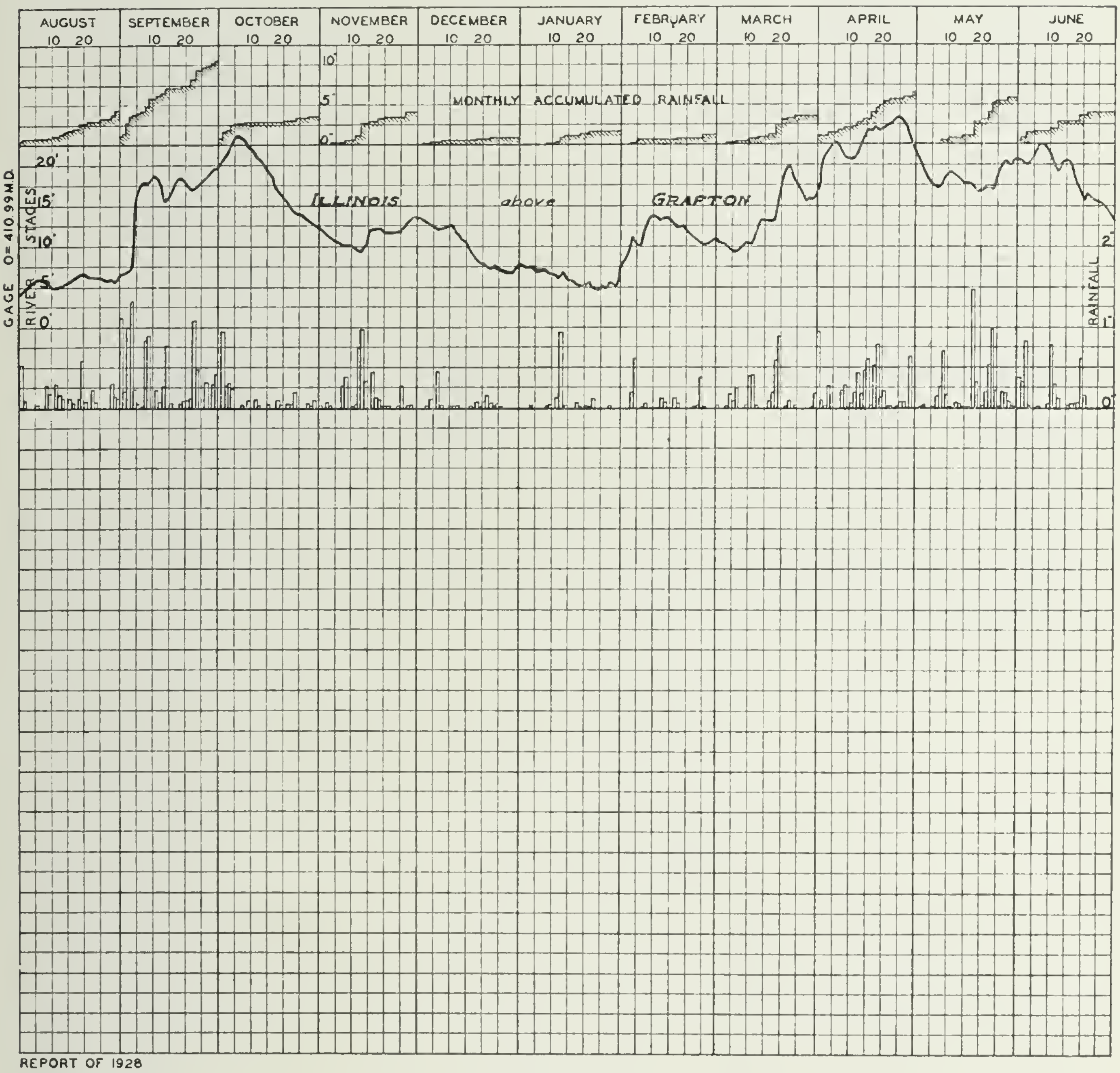

FIGURE A36

APPENDIX "B."

TABLE NO. B-1—REACHES FOR STORAGE AND BACK-WATER COMPUTATIONS.

Stations.*	Locations.†	Stations.*	Locations.†
0-15	Grafton.	613-633+300	Phelp's Lake.
15-50	Marshall's Landing.	633+300-655	Havana.
50-80	Coon Creek Landing.	655-676	Liverpool.
80-124	Hardin.	676-707	Clear Lake.
124-166	Keache's Landing.	707-722	Senate Island.
166-201	Kampsville.	722-760	Copperas Creek Lock.
201-227	Pearl Landing.	760-781	Kingston Mines.
227-264	Huck Horn Landing.	781-790	Mapleton.
264-299	Florence Landing.	790-807	Pekin Landing.
299-325	Griggsville Landing.	807-820	Pekin.
325-354	Earl's Ferry.	820-848	Wesley City, now Creve Coeur.
354-376	Meredosia Island.	848-855	Peoria.
376-397	Eagle Island.	855-877	Averyville.
397-409+750	LaGrange Locks.	877-882	Peoria Heights.
409+750-425	LaGrange Landing.	882-908	Mossville.
425-442	Reich's Landing.	908-948	Rome.
442-452	Briggs' Landing.	948-961	Chillicothe.
452-462	Grape Island.	961-1005	Lacon.
462-469	Beardstown.	1005-1034	Henry.
469-493	Frederick.	1034-1069	Swan Lake.
493-526	Browning.	1069-1093	Hennepin Lake.
526-542	Butlersville.	1093-1130	Hennepin.
542-572	Bluff City.	1130-1162	Spring Valley.
572-590	Anderson Lake.	1162-1185	Peru and LaSalle.
590-613	West Matanzas Lake.		

* NOTE.—Stations in 1,000 feet.
† Names of towns, ferries, landings, islands or lakes within each reach.

TABLE NO. B-2—ILLINOIS RIVER CROSS SECTION DATA—REFERRED TO CENTER OF REACH.

Mile 2.84 to Mile 9.47.

Station 15 to Station 50..................1901 Low Water Elevation 413.2. Width at Low Water 996 Feet. Area below Low Water 5,089 Square Feet. Distance 35,000 Feet.

Width over-bank	-----	403	929	1,819	2,273	3.230	4,980	5;104	5 450	5,840	6,124	6,496	6,690	6,906	7,029	7,093	7,136
Elevation	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436
Over-bank area	------	403	1,332	3,151	5,424	8,654	13,654	18,738	24,188	30,028	36,152	42,648	49,338	56,244	63,273	70,366	77,502
Channel area	11,862	12,858	13,854	14,850	15,846	16,842	17,838	18,834	19,830	20,826	21,822	22,818	23,814	24,810	25,806	26,802	27,798
Total area	11,862	13,261	15,186	17,001	21,270	25,496	31,472	37,572	44,018	50,854	57,974	65,466	73,152	81,054	89,079	97,168	105,300

Mile 9.47 to Mile 15.15.

Station 50 to Station 80..................1901 Low Water Elevation 413.8. Width at Low Water 901 Feet. Area below Low Water 4,588 Square Feet. Distance 30,000 Feet.

Width over-bank	------	98	198	337	1,032	1,687	3,212	4,330	5,310	5,743	6,190	6,717	6,842	6,948	7,053	7,153	7,235	7,305
Elevation	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437
Over-bank area	------	98	296	633	1.665	3.352	6,564	10,894	16.204	21,947	28,137	34,854	41,696	48,644	55,697	62,850	70,085	77,390
Channel area	10,174	11,075	11,976	12,877	13,778	14,677	15,580	16,481	17,382	18,283	19,184	20,085	20,986	21,887	22,788	23,699	24,590	25,491
Total area	10,174	11,173	12,272	13,510	15,443	18,031	22,144	27,375	33,586	40,230	47,321	54,939	62,682	70,531	78,485	86,539	94,675	102,881

Mile 15.15 to Mile 23.48.

Station 80 to Station 124................1901 Low Water Elevation 414.3. Width at Low Water 1,028 Feet. Area below Low Water 2,629 Square Feet. Distance 44,000 Feet.

Width over-bank	------	318	523	696	1,000	1,115	1,271	1,361	1,402	1,445	1,463	1,477	1,489	1,493	1,495
Elevation	425	426	427	248	429	430	431	432	433	434	435	436	437	438	439
Over-bank area	------	318	841	1.537	2,537	3,652	4,923	6.284	7,686	9.131	10,594	12,071	13,560	15,053	16,548
Channel area	13,629	14,657	15,685	16,713	17,741	18,769	19,797	20,825	21,853	22,881	23,909	24,937	25,965	26,993	28,021
Total area	13,629	14,975	15,526	18,250	20,278	22,421	24,720	27,109	29,539	32,012	34,503	36,008	39,525	42,046	44,569

TABLE NO. B-2—Continued.

Mile 23.48 to Mile 32.39.

Station 124 to Station 166..............1901 Low Water Elevation 417.4. Width at Low Water 925 Feet. Area below Low Water 5,560 Square Feet. Distance 42,000 Feet.

Width over-bank	146	195	269	464	787	1,196	1,593	1,814	2,427	2,790	3,055	3,205	3,285	3,355	3,416	3,474	3,552	3,633
Elevation	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
Over-bank area	146	341	610	1,074	1,861	3,057	4,650	6,464	8,891	11,681	14,736	17,941	21,226	24,581	27,997	31,471	35,023	38,656
Channel area	10.740	11,665	12,590	13,515	14,440	15,365	16,290	17,215	18,140	19,065	19,980	20,905	21,830	22.755	23,680	24,605	25,530	26,455
Total area	10,886	12,006	13,200	14,589	16,301	18,422	20,940	23,679	27,031	30,746	34,716	38,845	43,056	47,336	51,677	56,076	60,553	65,111

Mile 32.39 to Mile 38.06.

Station 166 to Station 201..............1901 Low Water Elevation 424.8. Width at Low Water 1209 Feet. Area below Low Water 10,294 Square Feet. Distance 35,000 Feet.

Width over-bank	28	60	100	134	171	279	452	483	829	862	886	911	935	954	980	980
Elevation	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441
Over-bank area	28	88	188	322	493	772	1,224	1,707	2,546	3,408	4,294	5,205	6,140	7,094	8,074	8,054
Channel area	11,744	12,953	14,162	15,371	16,580	17,789	18,998	20,207	21,416	22,625	23,834	25,043	26,252	27,461	28,670	29,879
Total area	11,772	13,041	14,350	15,693	17,073	18,561	20,222	21,914	23,962	26,033	28,128	30,248	32,392	34,555	36,744	38,933

Mile 38.06 to Mile 42.99.

Station 201 to Station 227..............1901 Low Water Elevation 425.0. Width at Low Water 1,215 Feet. Area below Low Water 8,803 Square Feet. Distance 26,000 Feet.

Width over-bank	27	75	127	180	240	405	515	712	985	1,175	1,273	1,350	1,440	1,522	1,597	1,672	1,697
Elevation	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442
Over-bank area	27	102	229	409	649	1,054	1,569	2,281	3,266	4,441	5,714	7,064	8,504	10,026	11,623	13,295	14,992
Channel area	10,018	11,233	12,448	13,663	14,878	16,093	17,308	18,523	19,738	20,953	22,168	23,383	24,598	25,813	27,028	28,243	29,458
Total area	10,045	11,335	12,677	14,072	15,527	17,147	18,877	20,804	23,004	25,394	27,882	30,447	33,102	35,839	38,651	41,538	44,450

Mile 42.99 to Mile 50.00.

Station 227 to Station 264..............1901 Low Water Elevation 425.4. Width at Low Water 1,010 Feet. Area below Low Water 7,032 Square Feet. Distance 37,000 Feet.

Width over-bank	59	106	158	200	268	419	621	819	983	1,031	1,238	1,321	1,406	1,486	1,555	1,593	1,628	1,688
Elevation	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444
Over-bank area	59	165	323	523	791	1,210	1,831	2,650	3,633	4,664	5,902	7,223	8,629	10,115	11,670	13,263	14,891	16,579
Channel area	8,648	9,658	10,668	11,678	12,688	13,698	14,708	15,718	16,728	17,738	18,748	19,758	20,768	21,778	22,788	23,798	24,808	25,818
Total area	8,707	9,823	10,991	12,201	13,479	14,908	16,539	18,368	20,361	22,402	24,650	26,981	29,397	31,893	34,458	37,061	39,669	42,397

Mile 50.00 to Mile 56.63.

Station 264 to Station 299..............1901 Low Water Elevation 425.7. Width at Low Water 914 Feet. Area below Low Water 66,999 Square Feet. Distance 35,000 Feet.

Width over-bank	89	123	168	214	255	295	491	701	765	779	820	846	886	908	940	976	1,004	1,024
Elevation	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446
Over-bank area	89	212	380	594	349	1,144	1,635	2,336	3,101	3,880	4,700	5,546	6,432	7,340	8,280	9,256	10,260	11,284
Channel area	9,715	10,629	11,543	12,457	13,371	14,285	15,199	16,113	17,027	17,941	18,855	19,769	20,683	21,597	22,511	23,425	24,339	25,253
Total area	9,804	10,841	11,923	13,051	14,220	15,429	16,834	18,449	20,128	21,821	23,555	25,315	27,115	28,937	30,791	32,681	34,599	36,537

Mile 56.63 to Mile 63.45.

Station 299 to Station 325..............1901 Low Water Elevation 426.1. Width at Low Water 756 Feet. Area below Low Water 6,130 Square Feet. Distance 26,000 Feet.

Width over-bank	197	241	339	395	653	922	1,114	1,196	1,251	1,313	1,377	1,413	1,442	1,483	1,504	1,528	1,531	1,535
Elevation	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448
Over-bank area	197	438	777	1,172	1,825	2,747	3,861	5,057	6,308	7,621	8,998	10,411	11,853	13,336	14,840	16,368	17,899	19,434
Channel area	9,834	10,590	11,346	12,102	12,858	13,614	14,370	15,126	15,882	16,638	17.394	18,150	18,906	19,662	20,418	21,174	21,930	22,686
Total area	10,031	11,028	12,123	13,274	14,683	16,361	18,231	20,183	22,190	24,259	26,392	28,561	30,759	32,998	35,258	37,542	39,829	42,120

TABLE NO. B-2—Continued.

Mile 63.45 to Mile 67.05.

Station 325 to Station 354..............1901 Low Water Elevation 426.5. Width at Low Water 870 Feet. Area below Low Water 4,885 Square Feet. Distance 29,000 Feet.

Width over-bank	133	180	252	318	505	707	1,020	1,170	1,230	1,280	1,340	1,380	1,435	1,460	1,480	1,482	1,483	1,487
Elevation	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448
Over-bank area	133	313	565	883	1,388	2,095	3,115	4,285	5,515	6,795	8,135	9,515	10,950	12,410	13,890	15,372	16,855	18,342
Channel area	8,800	9,670	10,540	11,410	12,280	13,150	14,020	14,890	15,760	16,630	17,500	18,370	19,240	20,110	20,980	21,850	22,720	23,590
Total area	8,933	9,983	11,105	12,293	13,668	15,245	17,135	19,175	21,275	23,425	25,635	27,885	30,190	32,520	34,870	37,222	39,575	41,932

Mile 67.05 to Mile 71.21.

Station 354 to Station 376..............1901 Low Water Elevation 427.1. Width at Low Water 852 Feet. Area below Low Water 5,732 Square Feet. Distance 22,000 Feet.

Width over-bank	1,736	776	883	939	1,294	1,401	1,659	1,979	2,170	2,300	2,317	2,327	2,334	2,334	2,343	2,350	2,356	2,363	2,369
Elevation	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449
Over-bank area	1,736	2,512	3,395	4,334	5,628	7,029	8,688	10,667	12,837	15,137	17,454	19,781	22,115	24,449	26,792	29,142	31,498	33,861	36,230
Channel area	9,140	9,992	10,844	11,696	12,548	13,400	14,252	15,104	15,956	16,808	17,660	18,512	19,364	20,216	21,068	21,920	22,772	23,624	24,476
Total area	10,076	12,404	14,239	16,030	18,276	20,439	22,940	25,771	28,793	31,945	35,114	38,293	41,479	44,665	47,860	51,062	54,270	57,485	60,706

Mile 71.21 to Mile 75.19.

Station 376 to Station 397..............1901 Low Water Elevation 427.8. Width at Low Water 723 Feet. Area below Low Water 4,969 Square Feet. Distance 21,000 Feet.

Width over-bank	11,492	3,690	4,102	4,444	4,558	4,798	5,160	5,272	5,360	5,446	5,604	5,772	5,834	5,842	5,850	5,858	5,870	5,882	5,886	5,890
Elevation	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
Over-bank area	11,492	15,182	19,284	23,728	28,286	33,084	38,244	43,516	48,876	54,322	59,926	65,698	71,332	77,374	83,224	89,082	94,952	100,834	106,720	112,610
Channel area	7,283	8,006	8,729	9,452	10,175	10,898	11,621	12,344	13,067	13,790	14,513	15,236	15,959	16,682	17,405	18,128	18,851	19,574	20,297	21,020
Total area	18,775	23,188	27,913	33,180	38,461	43,982	49,865	55,860	61,943	68,112	74,439	80,934	97,291	94,056	100,629	107,210	113,803	120,408	127,017	133,630

Mile 75.19 to Mile 78.41.

Station 397 to Station 409+750..........1901 Low Water Elevation 428.0. Width at Low Water 812 Feet. Area below Low Water 4,925 Square Feet. Distance 12,750 Feet.

Width over-bank..	(8,610)	4,390	5,010	5,490	5,610	6,120	6,600	7,440	7,740	7,980	8,300	8,610	8,750	8,750	8,750	8,750	8,750	8,750	8,750	8,750	8,750
Elevation....	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451
Over-bank area........	8,610	13,000	18,010	23,500	29,110	35,230	41,830	49,270	57,010	64,990	73,290	81,900	90,650	99,400	108,150	116,900	125,650	134,400	143,150	151,900	160,650
Channel area.	7,361	8,173	8,985	9,797	10,609	11,421	12,233	13,045	13,857	14,669	15,481	16,293	17,105	17,917	18,729	19,541	20,352	21,165	21,977	22,789	23,601
Total area	15,971	21,173	26,995	33,297	39,719	46,651	54,063	62,315	70,867	79,659	88,771	98,193	107,755	117.317	126,879	136,441	146,002	155,565	165,127	174,689	184,251

Mile 78.41 to Mile 80.49.

Station 409+750 to Station 425..........1901 Low Water Elevation 434.0. Width at Low Water 821 Feet. Area below Low Water 7,612 Square Feet. Distance 15,250 Feet.

Width over-bank..................................	1,380	2,110	2,580	2,900	3,150	3,390	3,610	3,770	3,830	3,860	3,870	3,880	3,882	3,890	3,894	3,898	3,902	3,910
Elevation..	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451
Over-bank area..................................	1,380	3,490	6,070	8,970	12,120	15,510	19,120	22,890	26,702	30,580	34,450	38,330	42,212	46,102	49,996	53,894	57,796	61,706
Channel area....................................	7,612	8,433	9,254	10,075	10,896	11,717	12,538	13,359	14,180	15,001	15,822	16,643	17,464	18,285	19,106	19,927	20,748	21,569
Total area......................................	8,992	11,923	15,324	19,045	23,016	27,227	31,658	36,249	40,882	45,581	50,272	54,973	59,676	64,387	69,102	73,821	78,544	83,275

Mile 80.49 to Mile 83.71.

Station 425 to Station 442................1901 Low Water Elevation 434.0. Width at Low Water 719 Feet. Area below Low Water 7,682 Square Feet. Distance 17,000 Feet.

Width over-bank..................................	18	70	.165	395	443	535	550	550	550	550	550	550	550	550	550	550	550	550
Elevation..	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452
Over-bank area..................................	18	88	253	789	1,241	1,776	2,326	2,876	3,426	3,976	4,526	5,076	5,626	6,176	6,726	7,276	7.826	8,376
Channel area....................................	8,401	9,120	9,839	10,558	11,277	11,996	12,715	13,434	14,153	14,872	15,591	16,310	17,029	17,748	18,467	19,186	19.905	20,624
Total area......................................	8,419	9,208	10,092	11,347	12,518	13,772	15,041	16,310	17,579	18,848	20,116	21,386	22,655	23,924	25,193	24,462	27,731	29,000

TABLE NO. B-2—Continued.

Mile 83.71 to Mile 85.61.

Station 442 to Station 452............1901 Low Water Elevation 434.0. Width at Low Water 935 Feet. Area below Low Water 8,146 Square Feet. Distance 10,000 Feet.

Width over-bank	85	140	220	415	550	750	750	750	750	750	750	750	750	750	750	750	750	750
Elevation	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453
Over-bank area	85	225	445	860	1,410	2,160	2,910	3,660	4,410	5,160	5,910	6,660	7,410	8,160	8,910	9,660	10,410	11,160
Channel area	10,016	10,951	11,886	12,821	13,756	14,691	15,626	16,561	17,496	18,431	19,366	20,301	21,236	22,171	23,106	24,041	24,976	25,911
Total area	10,101	11,176	12,331	13,681	15,166	16,851	18,536	20,221	22,906	23,591	25,276	26,961	28,646	30,331	32,016	33,701	35,386	37,071

Mile 85.61 to Mile 87.50.

Station 452 to Station 462..............1901 Low Water Elevation 434.0. Width at Low Water 868 Feet. Area below Low Water 7,236 Square Feet. Distance 10,000 Feet.

Width over-bank	97	470	517	673	830	923	930	943	943	950	950	950	950	950	950	950	950	950
Elevation	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453
Over-bank area	97	567	1,084	1,757	2,587	3,510	4,440	5,383	6,326	7,276	8,226	9,176	10,126	11,076	12,026	12,976	13,926	14,876
Channel area	8,972	9,840	10,708	11,576	12,444	13,312	14,180	15,048	15,916	16,784	17,652	18,520	19,388	20,256	21,124	21,992	22,860	23,728
Total area	9,069	10,407	11,792	13,333	15,031	16,822	18,620	20,431	22,242	24,060	25,878	27,696	29,514	31,332	33,150	34,968	36,786	38,604

Mile 87.50 to Mile 88.83.

Station 462 to Station 469..............1901 Low Water Elevation 434.0. Width at Low Water 934 Feet. Area below Low Water 8,083 Square Feet. Distance 7,000 Feet.

Width over-bank	133	227	550	817	950	950	950	950	950	950	950	950	950	950	950	950	950	950
Elevation	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area	133	360	910	1,727	2,677	3,627	4,577	5,527	6,477	7,427	8,377	9,327	10,277	11,227	12,177	13,127	14,077	15,027
Channel area	10,885	11,819	12,753	13,687	14,621	15,555	16,489	17,423	18,357	19,291	20,225	21,159	22,093	23,027	23,961	24,895	25,829	26,763
Total area	11,018	12,179	13,663	15,414	17,298	19,182	21,066	22,850	24,834	26,718	28,602	30,486	32,370	34,254	36,138	38,022	39,906	41,790

Mile 88.83 to Mile 93.37.

Station 469 to Station 493...............1901 Low Water Elevation 434.2. Width at Low Water 706 Feet. Area below Low Water 5,471 Square Feet. Distance 24,000 Feet.

Width over-bank.....	2,650	3,628	4,515	4,888	6,060	6,550	6,855	7,308	7,391	7,758	7,875	8,375	9,758	9,925	9,975	10,158	10,808	10,808	10,808	10,808	10,808
Elevation............	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area......	8,580	12,208	16,723	21,611	27,671	34,221	41,076	48,384	55,775	63,533	71,408	79,783	89,541	99,466	109,441	119,599	130,407	141,215	152,023	162,831	173,639
Channel area.........	9,413	10,119	10,825	11,531	12,237	12,943	13,649	14,355	15,061	15,767	16,473	17,179	17,885	18,591	19,297	20,003	20,709	21,415	22,121	22,827	23,533
Total area........	17,993	22,327	27,548	33,142	39,908	47,164	54,725	62,739	70,836	79,300	87,881	96,962	107,426	118,057	128,738	139,602	151,116	162,630	174,144	185,658	197,172

Mile 93.37 to Mile 99.62.

Station 493 to Station 526...............1901 Low Water Elevation 434.7. Width at Low Water 652 Feet. Area below Low Water 5,120 Square Feet. Distance 33,000 Feet.

Width over-bank..	2,467	3,562	4,050	6,443	7,597	11,605	12.743	14,782	16,365	17,752	19,308	19.895	21,065	21,785	22,636	23,623	23,623	23,623	23,623	23,623
Elevation.........	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area...	5,083	8,645	12,695	19,138	26,735	38,340	51,083	65,865	82,230	99,982	119,290	139,185	160,250	182,035	204,671	228,294	251,917	275,540	299,163	322,786
Channel area......	5,316	5,968	6,620	7,272	7,924	8,576	9,228	9,880	10,532	11,184	11,836	12,488	13,140	13,792	14,444	15,096	15,748	16,400	17,052	17,704
Total area....	10,399	14,613	19,315	26,410	34,659	46,916	60,311	75,743	92,762	111,166	131,126	151,673	173,390	195,827	219,115	243,390	267,665	291,940	316,215	340,490

Mile 99.62 to Mile 102.65.

Station 526 to Station 542...............1901 Low Water Elevation 435.0. Width at Low Water 509 Feet. Area below Low Water 5,423 Square Feet. Distance 16,000 Feet.

Width over-bank....	900	1.710	3,275	4,430	5,440	8,915	9,355	13,170	13,645	14,705	15,725	16 085	17,095	17,405	17,460	17,520	17,520	17,520	17,520	17,520
Elevation...........	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area.....	900	2,610	5,885	10,315	15,755	24.670	34,025	47,195	60,840	75,545	91,270	107,355	124,450	141,855	159,315	176,835	194,355	211,875	229,395	246,915
Channel area.......	5,513	6,022	6,531	7,040	7,549	8,058	8,567	9,076	9,585	10,094	10,603	11,112	11,621	12,130	12,639	13,148	13,657	14,168	14,675	15,184
Total area......	6,413	8,632	12,216	17,355	23,304	32,728	42,592	56,271	70,425	85,639	101,873	118,467	136,071	153,985	171,954	189,983	208,012	226,041	244,070	262,099

TABLE NO. B-2—Continued.

Mile 102.65 to Mile 108.33.

Station 542 to Station 572..............1901 Low Water Elevation 435.4. Width at Low Water 615 Feet. Area below Low Water 4,985 Square Feet. Distance 30,000 Feet.

Width over-bank	900	1,687	2,662	3,662	4,975	5,312	6,162	6,288	6,600	6,775	7,550	7,825	8,575	9,135	9,325	9,525	9,625	9,650	9,650	9,650
Elevation	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area	900	2,587	5,249	8,911	13,886	19,198	25,360	31,648	38,248	45,023	52,573	60,398	68,973	78,098	87,423	96,948	106,473	116,123	125,773	135,423
Channel area	4,739	5,354	5,969	6,584	7,199	7,814	8,429	9,044	9,659	10,274	10,889	11,504	12,119	12,734	13,349	13,964	14,579	15,194	15,809	16,424
Total area	5,639	7,941	11,218	15,495	21,085	27,012	33,789	40,692	47,907	55,297	63,462	71,902	81,092	90,832	100,772	110,912	121,052	131,317	141,582	151,847

Mile 108.33 to Mile 111.74.

Station 572 to Station 590..............1901 Low Water Elevation 435.7. Width at Low Water 738 Feet. Area below Low Water 4,504 Square Feet. Distance 18,000 Feet.

Width over-bank	2,625	3,150	4,662	5,575	7,375	8,685	9,607	9,905	10,050	10,220	10,575	11,250	11,250	11,250	11,250	11,250	11,250	11,250	11,250
Elevation	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454
Over-bank area	3,075	6,225	10,887	16,462	23,837	32,522	42,129	52,034	62,084	72,304	82,879	94,129	105,379	116,629	127,879	139,129	150,379	161,629	172,879
Channel area	4,725	5,463	6,201	6,939	7,677	8,415	9,153	9,891	10,629	11,367	12,105	12,843	13,581	14,319	15,057	15,795	16,533	17,271	18,009
Total area	7,800	11,688	17,088	23,401	31,514	40,937	51,282	61,925	72,713	83,671	94,984	106,972	118,960	130,948	142,936	154,924	166,912	178,900	190,888

Mile 111.74 to Mile 116.10.

Station 590 to Station 613..............1901 Low Water Elevation 435.8. Width at Low Water 730 Feet. Area below Low Water 4,427 Square Feet. Distance 23,000 Feet.

Width over-bank	1,050	1,450	2,875	4,915	5,475	6,025	6,215	6,220	6,220	6,225	6,225	6,225	6,230	6,230	6,235	6,235	6,235	6,235
Elevation	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455
Over-bank area	1,050	1,500	4,375	9,290	14,765	20,790	27,005	33,225	39,445	45,670	51,895	58,120	64,350	70,580	76,815	83,050	89,285	95,525
Channel area	6,033	6,763	7,493	8,223	8,953	9,683	10,413	11,143	11,873	12,603	13,333	14,063	14,793	15,523	16,253	16,983	17,713	18,443
Total area	7,083	8,263	11,868	17,513	23,718	30,473	37,418	44,368	51,318	58,273	65,228	72,183	79,143	86,103	93,068	100,033	106,998	113,968

Mile 116.10 to Mile 119.32.

Station 613 to Station 633.............1901 Low Water Elevation 436.0. Width at Low Water 694 Feet. Area below Low Water 4,848 Square Feet. Distance 20,000 Feet.

Width over-bank	180	180	450	847	1,124	1,212	1,255	1,260	1,267	1,272	1,280	1,283	1,294	1,298	1,308	1,312	1,322
Elevation	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455
Over-bank area	180	360	810	1,657	2,781	3,993	5,248	6,508	7,775	9,047	10,327	11,610	12,904	14,202	15,510	16,822	18,144
Channel area	6,930	7,624	8,318	9,012	9,706	10,400	11,094	11,788	12,482	13,176	13,870	14,564	15,258	15,952	16,646	17,340	18,034
Total area	7,110	7,984	9,128	10,669	12,487	14,393	16,342	18,296	20,257	22,223	24,197	26,174	28,162	30,154	32,156	34,162	36,178

Mile 119.32 to Mile 124.05.

Station 633 to Station 655.............1901 Low Water Elevation 436.2. Width at Low Water 1,114 Feet. Area below Low Water 4,420 Square Feet. Distance 22,000 Feet.

Width over-bank	817	850	975	1,158	1,175	1,192	1,208	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225	1,225
Elevation	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455
Over-bank area	2,717	3,567	4,542	5,700	6,875	8,067	9,275	10,500	11,725	12,950	14,175	15,400	16,625	17,850	19,075	20,300
Channel area	8,680	9,794	10,908	12,022	13,136	14,250	15,364	16,478	17,592	18,706	19,820	20,934	22,048	23,162	24,276	25,390
Total area	11,397	13,361	15,450	17,722	20,011	22,317	24,639	26,978	29,317	31,656	23,995	36,334	38,673	41,012	43,351	45,690

Mile 124.5 to Mile 129.55.

Station 655 to Station 676.............1901 Low Water Elevation 436.2. Width at Low Water 406 Feet. Area below Low Water 3,656 Square Feet. Distance 21,000 Feet.

Width over-bank	......	540	640	805	1,150	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170
Elevation	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456
Over-bank area	2,800	3,340	3,980	4,785	5,935	7,105	8,275	9,445	10,615	11,785	12,955	14,125	15,295	16,465	17,635	18,808	19,975	21,145
Channel area	4,793	5,199	5,605	6,011	6,417	6,823	7,229	7,635	8,041	8,447	8,853	9,259	9,665	10,071	10,477	10,883	11,289	11,695
Total area	7,593	8,539	9,585	10,796	12,352	13,928	15,504	17,080	18,656	20,232	21,808	23,384	24,960	26,536	28,112	29,691	31,264	32,840

TABLE NO. B-2—Continued.

Mile 129.55 to Mile 133.90.

Station 676 to Station 707..............1901 Low Water Elevation 436.8. Width at Low Water 581 Feet. Area below Low Water 3,606 Square Feet. Distance 31,000 Feet.

Width over-bank	------	2,860	3,740	3,825	3,995	4,460	4,610	4,650	4,710	4,770	4,820	4,830	4,830	4,830	4,830	4,830	4,830	4,830
Elevation	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456
Over-bank area	4,720	7,580	11,320	15,145	19,140	23,600	28,210	32,860	37,570	42,340	47,160	51,990	56,820	61,650	66,480	71,310	76,140	80,970
Channel area	4,884	5,465	6,046	6,627	7,208	7,789	8,370	8,951	9,532	10,113	10,694	11,275	11,856	12,437	13,018	13,599	14,180	14,161
Total area	9,604	13,045	17,366	21,772	26,348	31,389	36,580	41,811	47,102	52,453	57,854	63,265	68,676	74,087	79,498	84,909	90,320	95,131

Mile 133.90 to Mile 136.74.

Station 707 to Station 722..............1901 Low Water Elevation 437.0. Width at Low Water 654 Feet. Area below Low Water 3,872 Square Feet. Distance 15,000 Feet.

Width over-bank	2,830	4,770	5,750	6,000	6,430	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730	6,730
Elevation	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457
Over-bank area	5,060	9,830	15,580	21,580	28,010	34,740	41,470	48,200	54,930	61,660	68,390	75,120	81,850	88,580	95,310	102,040	108,770	115,500
Channel area	5,834	6,488	7,142	7,796	8,450	9,104	9,758	10,412	11,066	11,720	12,374	13,028	13,682	14,336	14,990	15,644	16,299	16,952
Total area	10,894	16,318	22,722	29,376	36,460	43,844	51,228	58,612	65,996	73,380	80,764	88,148	95,532	102,916	110,300	117,684	125,069	132,452

Mile 136.74 to Mile 143.94.

Station 722 to Station 760..............1901 Low Water Elevation 439.7. Width at Low Water 540 Feet. Area below Low Water 4,691 Square Feet. Distance 38,000 Feet.

Width over-bank	550	923	1,390	1,448	1,658	1,901	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012	2,012
Elevation	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458
Over-bank area	733	1,656	3,046	4,494	6,152	8,053	10,065	12,077	14,089	16,101	18,113	20,125	22,137	24,149	26,161	28,175	30,185	32,197
Channel area	5,393	5,933	6,473	7,013	7,553	8,093	8,633	9,173	9,713	10,253	10,793	11,333	11,873	12,413	12,953	13,493	14,033	14,573
Total area	6,126	7,589	9,519	11,507	13,705	16,146	18,698	21,250	23,802	26,354	28,906	31,458	34,010	36,562	39,114	41,668	44,218	46,770

Mile 143.94 to Mile 147.92.

Station 760 to Station 781..............1901 Low Water Elevation 439.7. Width at Low Water 680 Feet. Area below Low Water 5,824 Square Feet. Distance 21,000 Feet.

Width over-bank	8	23	53	105	338	735	1,155	1,250	1,285	1,325	1,338	1,343	1,343	1,345	1,348	1,353	1,355	1,358
Elevation	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458
Over-bank area	8	31	84	189	527	1,262	2,417	3,667	4,952	6,277	7,615	8,958	10,301	11,646	12,994	14,347	15,702	17,060
Channel area	6,708	7,388	8,068	8,748	9,428	10,108	10,788	11,468	12,148	12,828	13,508	14,188	14,868	15,548	16,228	16,908	17,588	18,268
Total area	6,717	7,419	8,152	8,937	9,955	11,370	13,205	15,135	17,100	19,105	21,123	23,146	25,169	27,194	29,222	31,255	33,290	35,328

Mile 147.92 to Mile 149.62.

Station 781 to Station 790..............1901 Low Water Elevation 439.7. Width at Low Water 583 Feet. Area below Low Water 4,022 Square Feet. Distance 9,000 Feet.

Width over-bank	590	380	410	650	1,110	1,690	2,040	2,080	2,120	2,170	2,200	2,210	2,220	2,230	2,240	2,250	2,270	2,270
Elevation	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458
Over-bank area	590	970	1,380	2,030	3,140	4,830	6,870	8,950	11,070	13,240	15,440	17,650	19,870	22,100	24,340	26,590	28,860	31,130
Channel area	4,780	5,363	5,946	6,529	7,112	7,695	8,278	8,861	9,444	10,027	10,610	11,193	11,776	12,359	12,942	13,525	14,108	14,691
Total area	5,370	6,333	7,326	8,559	10,252	12,525	15,148	17,811	20,514	23,267	26,050	28,843	31,646	34,459	37,282	40,115	42,968	45,821

Mile 149.62 to Mile 152.84.

Station 790 to Station 807..............1901 Low Water Elevation 439.7. Width at Low Water 702 Feet. Area below Low Water 5,097 Square Feet. Distance 27,000 Feet.

Width over-bank	45	78	115	190	288	318	350	363	363	363	363	363	363	363	363	363	363
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
Over-bank area	45	123	238	428	716	1,034	1,384	1,747	2,110	2,473	2,836	3,199	3,562	3,925	4,288	4,651	5,014
Channel area	7,414	8,116	8,818	9,520	10,222	10,924	11,626	12,328	13,030	13,732	14,434	15,136	15,838	16,540	17,242	17,944	18,646
Total area	7,459	8,239	9,056	9,948	10,938	11,958	13,010	14,075	15,140	16,205	17,270	18,335	19,400	20,465	21,530	22,595	23,660

TABLE NO. B-2—Continued.

Mile 152.84 to Mile 153.30.

Station 807 to Station 820..............1901 Low Water Elevation 440.0. Width at Low Water 506 Feet. Area below Low Water 3,730 Square Feet. Distance 13,000 Feet.

Width over-bank	1,125	1,125	1,145	1,895	2,125	2,260	2,550	2,725	2,725	2,725	2,725	2,725	2,725	2,725	2,725	2,725	2,725	2,725	2,725
Elevation	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
Over-bank area	1,125	2,250	3,395	5,290	7,415	9,675	12,225	14,950	17,675	20,400	23,125	25,850	28,875	31,300	34,025	36,750	39,475	42,200	44,925
Channel area	4,236	4,742	5,248	5,754	6,260	6,766	7,272	7,778	8,284	8,790	9,296	9,802	10,308	10,814	11,320	11,826	12,332	12,838	13,344
Total area	5,361	6,992	8,643	11,044	13,675	16,441	19,497	22,728	25,959	29,190	32,421	35,652	39,183	42,114	45,345	48,576	51,807	55,038	58,269

Mile 153.30 to Mile 160.61.

Station 820 to Station 848..............1901 Low Water Elevation 440.5. Width at Low Water 517 Feet. Area below Low Water 3,087 Square Feet. Distance 28,000 Feet.

Width over-bank	488	488	550	965	1,442	1,707	2,286	3,375	3.495	4,765	4,870	4,907	4,933	4,997	5,032	5,050	5,050	5,050	5,050
Elevation	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
Over-bank area	488	976	1,526	2,491	3,933	5,640	7,920	11,295	14,790	19,555	24,425	29,332	34,265	39,262	44,294	49,334	54,394	59,444	64,494
Channel area	3,346	3,863	4,380	4,897	5,414	5,931	6,448	6,965	7,482	7,999	8,516	9,033	9,550	10,067	10,584	11,101	11,618	12,135	12,652
Total area	3,834	4,839	5,906	7,388	9,347	11,571	14,368	18,260	22,272	27,554	32,941	38,365	43,815	49,329	54,878	60,435	66,012	71,579	77,146

Mile 160.61 to Mile 161.93.

Station 848 to Station 855..............1901 Low Water Elevation 441.1. Width at Low Water 694 Feet. Area below Low Water 2,605 Square Feet. Distance 7,000 Feet.

Width over-bank	13	48	88	115	140	153	173	185	193	205	215	225	240	245	250	250	250
Elevation	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461
Over-bank area	13	61	149	264	404	557	730	915	1,108	1,313	1,528	1,753	1,993	2,238	2,488	2,738	2,988
Channel area	5,312	6,006	6,700	7,394	8,088	8,782	9,476	10,170	10,864	11,558	12,252	12,946	13,640	14,334	15,028	15,722	16,416
Total area	5,325	6,067	6,849	7,658	8,492	9,339	10,206	11,085	11,972	12,871	13,780	14,699	15,633	16,572	17,416	18,460	19,404

Mile 161.93 to Mile 166.10.

Station 855 to Station 877..............1901 Low Water Elevation 441.3. Width at Low Water 1,485 Feet. Area below Low Water 12,137 Square Feet. Distance 22,000 Feet.

Width over-bank	1,226	1,596	2,176	2,386	2,456	2,546	2,616	2,696	2,746	2,776	2,826	2,866	2,896	2,936	2,976	3,006	3,056	3,066	3,066
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461
Over-bank area	4,580	6,176	8,352	10,738	13,194	15,740	18,356	21,052	23,798	26,574	29,400	32,266	35,162	38,098	41,074	44,080	47,136	50,202	53,268
Channel area	14,660	16,145	17,630	19,115	20,600	22,085	23,570	25,055	26,540	28,025	29,510	30,995	32,480	33,965	35,450	36,935	38,420	39,905	41,390
Total area	19,240	22,321	25,982	29,853	33,794	37,825	41,926	46,107	50,338	54,599	58,910	63,261	67,642	72,063	76,524	81,015	85,556	90,107	94,658

Mile 166.10 to Mile 167.05.

Station 877 to Station 882..............1901 Low Water Elevation 441.4. Width at Low Water 906 Feet. Area below Low Water 6,840 Square Feet. Distance 5,000 Feet.

Width over-bank	120	180	270	430	600	850	1,110	1,280	1,420	1,680	2,150	2,550	2,780	2,980	3,190	3,430	3,660	3,770	4,050
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461
Over-bank area	120	300	570	1,000	1,600	2,450	3,560	4,840	6,260	7,940	10,090	12,640	15,420	18,400	21,590	25,020	28,650	32,420	36,470
Channel area	8,290	9,196	10,102	11,008	11,914	12,820	13,726	14,632	15,538	16,444	17,350	18,256	19,162	20,068	20,974	21,880	22,786	23,692	34,598
Total area	8,410	9,496	10,672	12,008	23,514	15,270	17,286	19,472	21,798	24,384	27,440	30,896	34,582	38,466	42,564	46,900	51,436	56,112	61,068

Mile 167.05 to Mile 171.97.

Station 882 to Station 908..............1901 Low Water Elevation 441.5. Width at Low Water 2,168 Feet. Area below Low Water 17,480 Square Feet. Distance 26,000 Feet.

Width over-bank	3,497	3,947	4,137	4,287	4,477	4,602	4,647	4,890	4,982	5,010	5,362	5,445	5,595	5,717	5,815	5,929	6,025	6,110	6,291
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	462
Over-bank area	13,575	17,522	21,659	25,946	30,423	35,025	39,672	44,562	49.544	54,554	59,916	65,361	70.956	76,673	82,488	88,417	94,442	100,552	106,781
Channel area	20,732	22,900	25,068	27,236	29,404	31,572	33,740	35,908	38,076	40,244	42,412	44,580	46,748	48,916	51,084	53,252	55,420	57,588	59,756
Total area	34,307	40,422	46,727	53,182	59,827	66,597	73,412	80,470	87,620	94,798	102,328	109,941	117,704	125,599	133,572	141,669	149,862	158,140	166,537

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TABLE NO. B-2—Continued.

Mile 171.97 to Mile 179.55.

Station 908 to Station 948..............1901 Low Water Elevation 441.6. Width at Low Water 2,034 Feet. Area below Low Water 12,190 Square Feet. Distance 40,000 Feet.

Width over-bank	2,700	3,163	3,798	4,031	4,338	4,553	4,738	4,905	5,090	5,305	5,517	5,728	5,894	6,020	6,132	6,247	6,347	6,450	6,491
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461
Over-bank area	5,372	8,535	12,333	16,364	20,702	25,255	29,993	34,898	39,988	45,293	50,810	56,338	62,432	68,452	74,584	80,831	87,178	93,628	100,119
Channel area	15,038	17,072	19,106	21,140	23,174	25,208	27,242	29,276	31,310	33,344	35,378	37,412	39,446	41,480	43,514	45,548	47,582	49,616	51,650
Total area	20,410	25,607	31,439	37,504	43,876	50,463	57,235	64,174	71,298	78,637	86,188	93,750	101,878	109,932	118,098	126,379	134,760	143,244	151,769

Mile 179.55 to Mile 182.01.

Station 948 to Station 961..............1901 Low Water Elevation 441.7. Width at Low Water 792 Feet. Area below Low Water 7,310 Square Feet. Distance 13,000 Feet.

Width over-bank	78	315	645	838	915	965	988	1,015	1,055	1,133	1,160	1,165	1,165	1,170	1,170	1,170	1,170	1,175	1,175	1,180
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462
Over-bank area	78	393	1,038	1,876	2,791	3,756	4,744	5,759	6,814	7,947	9,107	10,272	11,437	12,607	13,777	14,947	16,117	17,292	18,467	19,647
Channel area	8,640	9,432	10,224	11,016	11,808	12,600	13,392	14,184	14,976	15,768	16,560	17,352	18,144	18,936	19,728	20,520	21,312	22,104	22,896	23,688
Total area	8,718	9,825	11,262	12,892	14,599	16,356	18,136	19,943	21,790	23,715	25,667	27,624	29,581	31,543	33,505	35,467	37,429	39,396	41,363	43,335

Mile 182.01 to Mile 190.35.

Station 961 to Station 1005..............1901 Low Water Elevation 441.7. Width at Low Water 860 Feet. Area below Low Water 9,259 Square Feet. Distance 44,000 Feet.

Width over-bank	350	466	958	1,944	2,770	3,519	3,664	4,115	4,531	4,840	5,052	5,264	5,521	5,719	5,859	6,019	6,222	6,331	6,391	6,452
Elevation	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462
Over-bank area	350	816	1,774	3,718	6,488	10,007	13,671	17,786	22,317	27,157	32,209	37,473	42,994	48,713	54,572	60,591	66,813	73,144	79,535	85,987
Channel area	10,377	11,237	12,097	12,957	13,817	14,677	15,537	16,397	17,257	18,117	18,977	19,837	20,697	21,557	22,417	23,277	24,137	24,997	25,857	26,717
Total area	10,727	12,053	13,871	16,675	20,305	24,684	29,208	34,183	39,574	45,274	51,186	57,310	63,691	70,270	76,989	83,868	90,950	98,141	105,492	112,704

Mile 190.35 to Mile 195.83.

Station 1005 to Station 1034............1901 Low Water Elevation 441.8. Width at Low Water 817 Feet. Area below Low Water 7,357 Square Feet. Distance 29,000 Feet.

Width over-bank	783	1,707	1,975	2,732	3.258	3,423	4,068	4,375	5,117	5,198	5,258	5,320	5,380	5,433	5,512	5,580	5,622	5,653	5,702	5,710	5,730
Elevation	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462
Over-bank area	783	2,490	4,465	8,197	11,455	13,878	18,946	23,321	28,438	33,636	38,894	44,214	49,594	55,027	60,539	66,119	71,741	77,394	83,096	88,806	94,536
Channel area	7,520	8,337	9,154	9,971	10,788	11,606	12,422	13,239	14,056	14,873	15,690	16,507	17,324	18,141	18,958	19,775	20,592	21,409	22,226	23,043	23,860
Total area	8,303	10,827	13,619	18,168	22,243	26,483	31,368	36,560	42,494	48,509	54,584	60,721	66,918	73,168	79,497	85,894	92,333	98,803	105,322	111,849	118,396

Mile 195.83 to Mile 202.46.

Station 1,034 to Station 1,069...........1901 Low Water Elevation 444.7. Width at Low Water 784 Feet. Area below Low Water 6,457 Square Feet. Distance 35,000 Feet.

Width over-bank	2,111	4,999	5,462	6,065	6,486	6,735	7,009	7,064	7,138	7,192	7,234	7,262	7,301	7,330	7,360	7,395	7,412	7,420
Elevation	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462
Over-bank area	2,111	7,110	12,572	18,637	25,123	31,858	38,867	45,931	53,069	60,261	67,495	74,757	82,058	89,388	96,748	104,143	111,555	118,975
Channel area	6,792	7,576	8,360	9,144	9,928	10,712	11,496	12,280	13,064	13,848	14,632	15,416	16,200	16,984	17,768	18,552	19,336	20,120
Total area	8,903	14,686	20,932	27,781	35,051	42,570	40,263	58,211	66,133	73,109	82,127	90,173	98,258	106,372	114,516	122,695	130,891	139,095

Mile 202.46 to Mile 207.01.

Station 1069 to Station 1093.............1901 Low Water Elevation 444.8. Width at Low Water 736 Feet. Area below Low Water 6,103 Square Feet. Distance 24,000 Feet.

Width over-bank	5,003	5,617	6,533	7,853	8,858	9,908	10,325	10,480	10,607	10,652	10,762	10,877	10,928	11,027	11,058	11,522	11,588	11,615
Elevation	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	452	463
Over-bank area	5,003	10,602	17,153	25,006	33,864	43,772	54,097	64,577	75,184	85,836	96,598	107,475	118,403	129,430	140,488	152,010	163,598	175,213
Channel area	6,968	7,722	8,458	9,194	9,930	10,666	11,402	12,138	12,874	13,610	14,346	15,082	15,818	16,554	17,290	18,026	18,762	19,498
Total area	11,989	18,324	25,611	34,200	43,894	54,438	65,499	76,715	88,058	99,446	110,944	122,557	134,221	146,984	157,778	170,036	182,360	194,711

TABLE NO. B-2—Concluded.

Mile 207.01 to Mile 214.02.

Station 1093 to Station 1130............1901 Low Water Elevation 444.9. Width at Low Water 733 Feet. Area below Low Water 5,570 Square Feet. Distance 37,000 Feet.

Width over-bank	1,005	1,035	1,644	2,975	3,949	5,499	5,918	6,174	6,406	6,699	7,076	7,240	7,347	7,417	7,521	7,949	8,332	8,347
Elevation	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463
Over-bank area	1,005	2,090	3,734	6,709	10,658	16,157	22,075	28,249	34,655	41,354	48,430	55,670	63,017	70,434	77,955	85,904	94,236	102,837
Channel area	7,376	8,109	8,842	9,575	10,308	11,041	11,774	12,507	13,240	13,973	14,706	15,439	16,172	16,905	17,638	18,371	19,104	19,837
Total area	8,381	10,199	12,576	16,284	20,966	27,198	33,849	40,756	57,895	55,327	63,136	71,109	79,189	87,339	95,593	104,275	113,340	122,420

Mile 214.02 to Mile 220.08.

Station 1130 to Station 1162............1901 Low Water Elevation 445.1. Width at Low Water 727 Feet. Area below Low Water 5,393 Square Feet. Distance 32,000 Feet.

Width over-bank	250	250	340	830	1,990	3,030	3,322	3,470	3,698	3,800	3,867	3,955	4,015	4,080	4,148	4,205	4,270	4,341
Elevation	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464
Over-bank area	250	500	840	1,670	3,660	6,690	10,012	13,482	17,180	20,980	24,847	28,802	32,817	36,897	41,045	45,250	49,520	53,861
Channel area	6,784	7,511	8,238	8,965	9,692	10,419	11,146	11,873	12,600	13,327	14,054	14,781	15,508	16,235	16,962	17,689	18,416	19,143
Total area	7,034	8,011	9,078	10,635	13,352	17,109	21,158	25,355	29,780	34,307	38,901	43,583	48,325	53,232	58,007	62,939	67,936	73,004

Mile 220.08 to Mile 224.43.

Station 1162 to Station 1185............1901 Low Water Elevation 445.5. Width at Low Water 500 Feet. Area below Low Water 3,369 Square Feet. Distance 23,000 Feet.

Width over-bank	200	200	460	932	1,257	2,077	2,537	2,955	3,455	3,705	3,927	4,027	4,397	4,520	4,555	4,595	4,632	4,660
Elevation	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464
Over-bank area	200	400	860	1,792	3,049	5,126	7,663	10,618	14,073	17,778	21,705	25,732	30,129	34,649	39,204	43,799	48,431	53,091
Channel area	4,119	4,619	5,119	5,619	6,119	6,619	7,119	7,619	8,119	8,619	9,119	9,619	10,119	10,619	11,119	11,619	12,119	12,619
Total area	4,319	5,019	5,979	7,411	9,168	11,745	14,782	18,237	22,192	26,397	30,824	35,351	40,248	45,268	50,323	55,418	60,550	65,710

TABLE NO. B-3—ILLINOIS RIVER—STORAGE ABOVE BANK FULL STAGE.

From Station 15 to Station 201.

Elevation center reach.	Station 15-50. Length 35,000 ft.		Station 50-80. Length 30,000 ft.		Station 80-124. Length 44,000 ft.		Station 124-171. Length 47,000 ft.		Station 171-201. Length 30,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
421	—	1,124	—	688	—	—	—	—	—	—
422	1,546	2,670	756	1,444	—	—	—	—	—	—
423	2,262	4,932	853	2,297	—	—	—	1,242	—	—
424	2,627	7,559	1,331	3,628	—	—	1,296	2,538	—	—
425	3,395	10,954	1,783	5,411	—	—	1,376	3,914	—	—
426	4,802	15,756	2,832	8,243	—	1,356	1,590	5,504	—	855
427	4,901	20,657	3,603	11,846	1,576	2,926	1,941	7,445	883	1,738
428	5,177	25,834	4,277	16,123	1,741	4,667	2,387	9,832	889	2,627
429	5,496	31,330	4,576	20,699	2,049	6,716	2,819	12,651	964	3,591
430	5,720	37,050	4,884	25,583	2,164	8,880	3,049	15,700	965	4,556
431	6,020	43,070	5,246	30,829	2,323	11,203	3,727	19,427	1,083	5,639
432	7,325	50,395	5,333	36,162	2,413	13,616	4,130	23,557	1,242	6,881
433	6,349	56,744	5,405	41,567	2,454	16,070	4,418	27,975	1,282	8,163
434	6,448	63,192	5,478	47,045	2,498	18,568	4,579	32,554	1,533	9,696
435	6,500	69,692	5,547	52,592	2,516	21,084	4,665	37,219	1,567	11,263
436	6,534	76,226	5,603	58,195	2,531	23,615	4,744	41,963	1,581	12,844
437	6,534	82,760	5,652	63,847	2,542	26,157	4,812	46,775	1,599	14,443
438	6,534	82,294	5,651	69,498	2,547	28,704	4,881	51,656	1,613	16,056
439	6,534	95,828	5,652	75,150	2,548	31,252	4,968	56,624	1,631	17,687
440	6,534	102,362	5,651	80,801	2,548	33,800	5,058	61,682	1,644	19,331
441	—	—	5,652	86,453	2,549	36,349	5,059	66,741	1,667	20,998
442	—	—	—	—	2,048	38,397	5,057	71,798	1,666	22,664
443	—	—	—	—	3,049	41,446	5,058	76,856	1,667	24,331
444	—	—	—	—	—	—	5,058	81,914	1,667	25,998
445	—	—	—	—	—	—	—	—	1,666	27,664

TABLE NO. B-3—Continued.

From Station 201 to Station 354

Elevation center reach.	Station 201-227. Length 26,000 ft.		Station 227-264. Length 37,000 ft.		Station 264-299. Length 35,000 ft.		Station 299-335. Length 36,000 ft.		Station 335-354. Length 19,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
426	—	741	—	—	—	—	—	—	—	—
427	770	1,511	—	908	—	—	—	—	—	—
428	801	2,312	948	1,856	—	—	—	—	—	—
429	833	3,145	992	2,848	—	806	—	—	—	—
430	868	4,013	1,028	3,876	833	1,639	—	—	—	—
431	967	4,980	1,085	4,961	869	2,508	—	806	—	427
432	1,032	6,012	1,214	6,175	906	3,414	888	1,694	433	860
433	1,150	7,162	1,386	7,561	940	4,354	914	2,608	453	1,313
434	1,313	8,475	1,553	9,114	971	5,325	992	3,600	478	1,791
435	1,427	9,902	1,693	10,807	1,129	6,454	1,056	4,656	502	2,293
436	1,484	11,386	1,734	12,541	1,297	7,751	1,271	5,927	526	2,819
437	1,531	12,917	1,909	14,450	1,349	9,100	1,585	7,512	558	3,377
438	1,585	14,502	1,980	16,430	1,360	10,460	1,775	9,287	566	3,943
439	1,633	16,135	2,052	18,482	1,393	11,853	1,840	11,127	579	4,522
440	1,678	17,813	2,120	20,602	1,414	13,267	1,903	13,030	582	5,104
441	1,723	19,536	2,179	22,781	1,446	14,713	2,191	15,221	610	5,714
442	1,738	21,274	2,211	24,992	1,464	16,177	1,769	16,990	626	6,340
443	1,738	23,012	2,241	27,233	1,492	17,669	2,030	19,020	642	6,982
444	1,738	24,750	2,291	29,524	1,516	19,185	2,050	21,070	658	7,640
445	1,738	26,488	2,292	31,816	1,541	20,726	2,058	23,128	677	8,317
446	1,738	28,226	2,292	34,108	1,557	22,283	2,074	25,202	676	8,993
447	1,738	29,964	2,291	36,399	1,557	23,840	2,075	27,277	677	9,670
448	—	—	2,292	38,691	1,557	25,397	2,077	29,354	678	10,348
449	—	—	2,292	40,983	1,557	26,954	2,076	31,430	678	11,026
450	—	—	—	—	1,557	28,511	2,077	33,507	678	11,704
451	—	—	—	—	1,557	30,068	2,077	35,584	678	12,382
452	—	—	—	—	—	—	—	—	678	13,060

TABLE NO. B-3—Continued.

From Station 354 to Station 442.

Elevation center reach.	Station 354-376. Length 22,000 ft.		Station 376-397. Length 21,000 ft.		Station 397-414. Length 17,000 ft.		Station 414-425. Length 11,000 ft.		Station 425-442. Length 17,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
431	--------	1,307	--------	5,888	--------	--------	--------	--------	--------	--------
432	822	2,129	2,127	8,015	--------	--------	--------	--------	--------	--------
433	876	3,005	2,325	10,340	--------	--------	--------	--------	--------	--------
434	905	3,910	2,491	12,831	--------	2,278	--------	--------	--------	--------
435	1,083	4,993	2,545	15,376	2,406	4,684	--------	587	--------	288
436	1,138	6,131	2,661	18,037	2,643	7,327	684	1,271	307	595
437	1,268	7,399	2,836	20,873	2,815	10,142	759	2,030	345	940
438	1,430	8,829	2,890	23,763	3,093	13,235	816	2,846	435	1,375
439	1,526	10,355	2,931	26,694	3,208	16,443	875	3,721	453	1,828
440	1,592	11,947	2,974	29,668	3,314	19,757	934	4,655	490	2,318
441	1,600	13,547	3,050	32,718	3,429	23,186	953	5,608	495	2,813
442	1,606	15,153	3,130	35,848	3,541	26,727	902	6,510	495	3,308
443	1,608	16,761	3,161	39,009	3,586	30,313	970	7,480	495	3,803
444	1,609	18,370	3,164	42,173	3,588	33,901	973	8,453	495	4,298
445	1,614	19,984	3,168	45,341	3,589	37,490	974	9,427	496	4,794
446	1,617	21,601	3,172	48,513	3,589	41,079	975	10,402	495	5,289
447	1,620	23,221	3,178	51,691	3,589	44,668	978	11,380	495	5,784
448	1,623	24,844	3,183	54,874	3,589	48,257	980	12,360	495	6,279
449	1,627	26,471	3,186	58,060	3,589	51,846	981	13,341	495	6,774
450	1,627	28,098	3,188	61,248	3,589	55,435	982	14,323	495	7,269
451	1,626	29,724	3,187	64,435	3,589	59,024	984	15,307	496	7,765
452	1,627	31,351	3,188	67,623	3,589	62,613	985	16,292	495	8,260
453	1,627	32,978	3,187	70,810	3,589	66,202	984	17,276	495	8,755
454	1,626	34,604	3,188	73,998	3,511	69,713	985	18,261	495	9,250
455	--------	--------	3,187	77,185	3,667	73,380	984	19,245	495	9,745
456	--------	--------	3,188	80,373	3,589	76,969	985	20,230	495	10,240
457	--------	--------	--------	--------	--------	--------	--------	--------	495	10,736

TABLE NO. B-3—Continued.

From Station 442 to Station 526.

Elevation center reach.	Station 442-452. Length 10,000 ft.		Station 452-462. Length 10,000 ft.		Station 462-469. Length 7,000 ft.		Station 469-493. Length 24,000 ft.		Station 493-526. Length 33,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
435	--------	--------	--------	--------	--------	--------	--------	1,809	--------	--------
436	--------	234	--------	221	--------	--------	2,930	4,739	--------	1,840
437	247	481	308	529	--------	171	3,440	8,179	3,197	5,037
438	265	746	317	846	187	358	3,574	11,753	4,873	9,910
439	310	1,056	354	1,200	238	596	3,828	15,581	6,760	16,670
440	341	1,397	390	1,590	281	877	4,082	19,663	9,702	26,372
441	386	1,783	411	2,001	303	1,180	4,526	24,189	10,411	36,783
442	387	2,170	412	2,413	302	1,482	4,597	28,786	12,877	49,660
443	387	2,557	416	2,829	303	1,785	4,674	33,460	13,292	62,952
444	386	2,943	416	3,245	303	2,088	4,748	38,208	13,729	76,681
445	387	3,330	417	3,662	302	2,390	4,789	42,997	13.875	90,556
446	387	3,717	417	4,079	303	2,693	5,367	48,364	14,276	104,832
447	386	4,103	417	4,496	302	2,995	5,436	53,800	14,525	119,357
448	387	4,490	418	4,914	303	3,298	5,481	59,281	14,742	134,099
449	387	4,877	417	5,331	302	3,600	5,501	64,782	14,830	148,929
450	387	5,264	417	5,748	303	3,903	5,546	70,328	14,919	163,848
451	386	5,650	417	6,165	303	4,206	5,605	75,933	15,009	178,857
452	387	6,037	417	6,582	302	4,508	5,595	81,528	15,014	193,871
453	387	6,424	418	7,000	303	4,811	5,604	87,132	14,877	208,748
454	386	6,810	417	7,417	302	5,113	5,606	92,738	15,411	224,159
455	387	7,197	417	7,834	303	5,416	5,606	98,344	15,272	239,431
456	387	7,584	417	8,251	302	5,718	5,606	103,950	15,273	254,704
457	387	7,971	418	8,669	303	6,021	5,606	109,556	15,274	269,978
458	386	8,357	417	9,086	303	6,324	5,606	115,162	15,272	285,250
459	--------	--------	--------	--------	302	6,626	5,606	120,768	15,272	300,522
460	--------	--------	--------	--------	--------	--------	--------	--------	15,273	315,795

TABLE NO. B-3—Continued

From Station 526 to Station 630.

Elevation center reach.	Station 526-542. Length 16,000 ft.		Station 542-572. Length 30,000 ft.		Station 572-590. Length 18,000 ft.		Station 590-613. Length 23,000 ft.		Station 613-630. Length 17,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
436		738		1,911						
437	1,226	1,964	2,641	4,552		1,133				
438	1,662	3,626	3,296	7,848	1,376	2,509		940		
439	2,062	5,688	3,808	11,656	1,589	4,098	623	1,563		360
440	3,471	9,159	4,227	15,883	3,007	7,105	1,903	3,466	360	720
441	3,762	12,921	4,659	20,532	3,421	10,526	2,981	6,447	489	1,209
442	5,227	18,148	4,771	25,303	3,726	14,252	3,276	9,723	678	1,887
443	5,437	23,585	5,248	30,551	4,020	18,272	3,567	13,290	807	2,694
444	6,106	29,691	5,456	36,007	4,296	22,568	3,667	16,957	843	3,537
445	6,277	35,968	5,730	41,737	4,504	27,072	3,669	20,626	859	4,396
446	6,688	42,656	6,300	48,037	4,972	32,044	3,670	24,296	859	5,255
447	6,696	49,352	6,383	54,420	4,977	37,021	3,672	27,968	862	6,117
448	6,702	56,054	6,425	60,845	4,981	42,002	3,672	31,640	863	6,980
449	6,712	62,766	6,621	67,466	4,986	46,988	3,673	35,313	865	7,845
450	6,718	69,484	6,682	74,148	4,990	51,978	3,675	38,988	867	8,712
451	6,727	76,211	6,770	80,918	4,993	56,971	3,674	42,662	869	9,581
452	6,734	82,945	6,820	87,738	4,998	61,969	3,678	46,340	871	10,452
453	6,741	89,686	6,884	94,622	5,003	66,972	3,677	50,017	873	11,325
454	6,749	96,435	6,951	101,573	5,009	71,981	3,678	53,695	873	12,198
455	6,749	103,184	6,951	108,524	5,008	76,989	3,680	57,375	876	13,074
456	6,749	109,933	6,951	115,475	5,008	81,997	3,680	61,055	877	13,951
457	6,748	116,681	6,951	122,426	5,009	87,006	3,680	64,735	876	14,827
458	6,749	123,430	6,951	129,377	5,008	92,014	3,681	68,416	877	15,704
459	6,749	130,179	6,951	136,328	5,008	97,022	3,680	72,096	876	16,580
460							3,680	75,776	876	17,45

TABLE NO. B-3—Continued.

From Station 630 to Station 760.

Elevation center reach.	Station 630-655. Length 25,000 ft.		Station 655-684. Length 29,000 ft.		Station 684-707. Length 23,000 ft.		Station 707-722. Length 22,000 ft.		Station 722-760. Length 31,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
439				673		3,805				
440			573	1,246	2,093	5,898		1,277		
441		1,070	870	2,116	2,589	8,487	1,985	3,262		
442	1,079	2,149	936	3,052	3,102	11,589	3,574	6,836		406
443	1,085	3,234	973	4,025	3,426	15,015	3,813	10,649	421	827
444	1,099	4,333	1,004	5,029	3,482	18,497	4,018	14,667	484	1,311
445	1,110	5,443	1,076	6,105	3,618	22,115	4,159	18,826	626	1,937
446	1,117	6,560	1,083	7,188	3,649	25,764	4,264	23,090	829	2,766
447	1,122	7,682	1,093	8,281	3,675	29,439	4,300	27,390	939	3,705
448	1,122	8,804	1,104	9,385	3,699	33,138	4,334	31,724	954	4,659
449	1,127	9,931	1,116	10,501	3,723	36,861	4,374	36,098	953	5,612
450	1,128	11,059	1,124	11,625	3,750	40,611	4,410	40,508	954	6,566
451	1,128	12,187	1,131	12,756	3,781	44,392	4,445	44,953	953	7,519
452	1,136	13,323	1,131	13,887	3,818	48,210	4,482	49,435	954	8,473
453	1,139	14,462	1,131	.15,018	3,833	52,043	4,521	53,956	954	9,427
454	1,142	15,604	1,131	16,149	3,834	55,877	4,556	58,512	953	10,380
455	1,148	16,752	1,131	17,280	3,834	59,711	4,597	63,109	954	11,334
456	1,148	17,900	1,131	18,411	3,834	63,545	4,629	67,738	953	12,287
457	1,148	19,048	1,131	19,542	3,834	67,379	4,654	72,392	954	13,241
458	1,148	20,196	1,131	20,673	3,833	71,212	4,654	77,046	953	14,194
459	1,147	21,343	1,131	21,804	3,834	75,046	4,654	81,700	954	15,148
460	1,148	22,491	1,131	22,935	3,834	78,880	4,654	86,354	953	16,101
461			1,131	24,066	3,834	82,714	4,654	91,008	954	17,055
462							4,654	95,662	953	18,008
463									954	18,962

TABLE NO. B-3—Continued.

From Station 760 to Station 848.

Elevation center reach.	Station 760-781. Length 21,000 ft.		Station 781-790. Length 9,000 ft.		Station 790-807. Length 17,000 ft.		Station 807-820. Length 13,000 ft.		Station 820-848. Length 28,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
441	--------	332	--------	242	--------	----------	--------	558	--------	656
442	338	670	199	441	--------	----------	557	1,115	795	1,451
443	354	1,024	205	646	--------	291	574	1,689	816	2,267
444	378	1,402	255	901	305	596	755	2,444	1,104	3,371
445	491	1,893	350	1,251	319	915	899	3,343	1,273	4,644
446	682	2,575	470	1,721	348	1,263	925	4,268	1,698	6,342
447	884	3,459	541	2,262	386	1,649	952	5,225	2,091	8,433
448	931	4,390	551	2,813	398	2,047	995	6,220	2,931	11,364
449	947	5,337	558	3,371	410	2,457	994	7,214	3,347	14,711
450	966	6,303	569	3,940	416	2,873	997	8,211	3,770	18,481
451	973	7,276	575	4,515	416	3,289	998	9,209	3,944	22,425
452	975	8,251	577	5,092	415	3,704	1,001	10,210	4,053	26,478
453	975	9,226	579	5,671	416	4,120	1,002	11,212	4,156	30,634
454	976	10,202	581	6,252	415	4,535	1,004	12,216	4,236	34,870
455	978	11,180	583	6,835	416	4,951	1,007	13,223	4,258	39,128
456	979	12,159	586	7,421	415	5,366	1,007	14,230	4,262	43,390
457	981	13,140	589	8,010	416	5,782	1,006	15,236	4,269	47,659
458	983	14,123	590	8,600	416	6,198	1,007	16,243	4,275	51,934
459	982	15,105	589	9,189	415	6,613	1,006	17,249	4,278	56,212
460	982	16,087	589	9,778	416	7,029	1,007	18,256	4,280	60,492
461	983	17,070	590	10,368	415	7,444	1,006	19,262	4,281	64,773
462	982	18,052	589	10,957	416	7,860	1,007	20,269	4,281	69,054
463	982	19,034	590	11,547	415	8,275	1,006	21,275	4,280	73,334
464	--------	----------	--------	----------	416	8,691	1,007	22,282	4,280	77,614
465	--------	----------	--------	----------	--------	----------	1,006	23,288	4,281	81,895

TABLE NO. B-3—Continued.

From Station 848 to Station 961.

Elevation center reach.	Station 848-855. Length 7,000 ft.		Station 855-879. Length 24,000 ft.		Station 879-908. Length 29,000 ft.		Station 908-948. Length 40,000 ft.		Station 948-961. Length 13,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
443	--------	----------	--------	1,379	--------	3,611	--------	4,347	--------	260
444	--------	----------	1,514	2,893	3,911	7,522	4,772	9,119	330	590
445	--------	114	1,704	4,597	4,038	11,560	5,355	14,474	429	1,019
446	119	233	1,807	6,404	4,137	15,697	5,568	20,042	486	1,505
447	125	358	1,878	8,282	4,264	19,961	6,402	26,444	509	2,014
448	130	488	1,961	10,243	4,347	24,308	5,497	31,941	525	2,539
449	134	622	2,040	12,283	4,377	28,685	6,218	38,159	531	3,070
450	136	758	2,122	14,405	4,539	33,224	5,372	44,531	539	3,609
451	139	897	2,191	16,596	4,600	37,824	6,541	51,072	539	4,148
452	142	1,039	2,287	18,883	5,618	42,442	6,739	57,811	587	4,735
453	142	1,187	2,283	21,166	4,787	47,229	6,933	64,744	582	5,317
454	144	1,325	2,701	23,867	4,908	52,137	7,127	71,871	584	5,901
455	146	1,471	2,708	26,575	5,008	57,145	7,280	79,151	574	6,495
456	148	1,619	2,770	29,345	5,089	62,234	7,395	86,546	576	7,071
457	150	1,769	2,841	32,186	5,155	67,389	7,498	94,044	585	7,656
458	151	1,920	2,928	35,114	5,230	72,617	7,603	101,647	586	8,242
459	151	2,071	3,015	38,129	5,295	77,914	7,696	109,343	585	8,827
460	152	2,223	3,061	41,190	5,350	83,264	7,790	117,133	587	9,414
461	152	2,375	3,100	44,290	5,431	88,695	7,828	124,961	587	10,001
462	151	2,526	3,099	47,389	5,430	94,125	7,827	132,788	588	10,589
463	152	2,678	3,099	50,488	5,430	99,555	7,828	140,616	589	11,178
464	151	2,829	3,100	53,588	5,430	104,985	7,828	148,444	588	11,766
465	152	2,981	3,099	56,687	5,430	110,415	7,827	156,271	589	12,355
466	152	3,133	3,099	59,786	5,430	115,845	7,828	164,099	588	12,943
467	--------	----------	--------	----------	--------	----------	--------	----------	589	13,532

TABLE NO. B-3—Continued.

From Station 961 to Station 1130.

Elevation center reach.	Station 961-1005. Length 44,000 ft.		Station 1005-1034. Length 29,000 ft.		Station 1034-1069. Length 35,000 ft.		Station 1069-1093. Length 24,000 ft.		Station 1093-1130. Length 37,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
442	--------	----------	--------	1,065	--------	----------	--------	----------	--------	--------
443	--------	1,222	1,680	2,745	--------	----------	--------	----------	--------	--------
444	1,340	2,562	1,859	4,604	--------	----------	--------	----------	--------	--------
445	1,836	4,398	2,363	6,967	--------	2,326	--------	----------	--------	--------
446	2,832	7,230	2,712	9,679	4,646	6,972	--------	3,162	--------	1,476
447	3,667	10,897	2,823	12,502	5,018	11,990	3,499	6,661	1,544	3,020
448	4,423	15,320	3,252	15,754	5,502	17,492	4,005	10,666	2,019	5,039
449	4,570	19,890	3,456	19,210	5,841	23,333	4,732	15,398	3,150	8,189
450	5,025	24,915	3,950	23,160	5,318	28,651	5,285	20,683	3,977	12,166
451	5,446	30,361	4,005	27,165	6,984	35,635	5,864	26,547	5,293	17,459
452	5,757	36,118	4,044	31,209	6,305	41,940	6,093	32,640	5,650	23,109
453	5,972	42,090	4,085	35,294	6,364	48,304	8,162	40,802	5,867	28,976
454	6,186	48,276	4,125	39,419	6,408	54,712	4,266	45,068	6,063	35,038
455	6,445	54,721	4,161	43,580	6,412	61,154	6,274	51,342	6,313	41,352
456	6,646	61,367	4,213	47,793	6,464	67,618	6,334	57,676	6,633	47,985
457	6,786	68,153	4,259	52,052	6,496	74,114	6,398	64,074	6,772	54,757
458	6,949	75,102	4,286	56,338	6,518	80,632	6,425	70,499	6,864	61,621
459	7,153	82,255	4,307	60,645	6,608	87,240	6,480	76,979	6,922	68,543
460	7,265	89,520	4,340	64,985	6,506	93,746	6,498	83,477	7,011	75,554
461	7,323	96,843	4,345	69,330	6,585	100,331	6,758	90,235	7,375	82,929
462	7,386	104,229	4,358	73,688	6,591	106,922	6,784	97,019	7,699	90,628
463	7,386	111,615	4,359	78,047	6,591	113,513	6,804	103,823	7,713	98,341
464	7,385	119,000	4,358	82,405	6,591	120,104	6,804	110,627	7,713	106,054
465	7,387	126,387	4,358	86,763	6,596	126,700	6,804	117,431	7,712	113,766
466	7,386	133,773	4,359	91,122	6,586	133,286	6,805	124,236	7,713	121,479
467	7,385	141,158	4,358	95,480	6,592	139,878	6,804	131,040	7,712	129,191
468	--------	----------	--------	----------	--------	----------	6,804	137,844	7,713	136,904

TABLE NO. B-3—Concluded.

From Station 1130 to Station 1219.

Elevation center reach.	Station 1130-1162. Length 32,000 ft.		Station 1162-1194. Length 32,000 ft.		Station 1194-1219. Length 25,000 ft.	
	Diff.	Ac. ft.	Diff.	Ac. ft.	Diff.	Ac. ft.
447	------------	718	------------	568	------------	------------
448	717	1,435	568	1,136	------------	314
449	784	2,219	784	1,920	338	652
450	1,144	3,363	1,215	3,135	421	1,073
451	1,993	5,359	1,438	4,573	599	1,672
452	2,760	8,119	1,906	6,479	673	2,345
453	2,974	11,093	2,219	8,698	806	3,151
454	3,086	14,176	2,477	11,175	894	4,045
455	3,251	17,427	2,871	14,046	1,164	5,209
456	3,325	20,752	3,019	17,065	1,328	6,537
457	3,375	24,127	3,153	20,218	1,594	8,131
458	3,440	27,567	3,230	23,448	1,780	9,911
459	3,483	31,050	3,440	26,888	1,965	11,876
460	3,531	34,581	3,614	30,502	2,237	14,113
461	3,581	38,162	3,639	34,141	2,290	16,403
462	3,624	41,786	3,667	37,808	2,398	18,801
463	3,670	45,456	3,694	41,502	2,467	21,268
464	3,723	49,179	3,715	45,217	2,524	23,792
465	3,723	52,902	3,715	48,932	2,596	26,388
466	3,723	56,625	3,715	52,647	2,596	28,984
467	3,723	60,348	3,714	56,361	2,595	31,579
468	3,723	64,071	3,715	60,076	2,596	34,175
469	3,723	67,794	3,715	63,791	2,596	36,771
470	------------	------------	------------	------------	2,596	39,367

TABLE NO. B-4.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER NEAR DIVINE, ILLINOIS.

Gauge readings refer to gauge on E., J. & E. Railroad Bridge.
Elevation of zero gauge=491.12 Memphis Datum.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1925										
1	June 17	3.60	494.72	5,314	16.2	549	2.13	11,321	S	S.D.C.	Meter submerged .6 of depth
2	April 6	4.60	495.72	5,554	16.7	555	2.15	11,921	S	S.D.C.	Meter submerged .6 of depth.

Note—Current meter measurements taken at E., J. & E. Railroad Bridge.
"S" indicates stationary river.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT MORRIS, ILLINOIS.

Gauge readings refer to gauge on Morris Highway Bridge.
Elevation of zero gauge=485.86 Memphis Datum.

	1920										
1	Mar. 30	13.10	498.96	9,130	....	629	2.98	27,200	....	U.S.G.S.	
2	April 13	10.03	495.89	7,160	....	629	2.68	19,200	....	U.S.G.S.	
3	May 10	8.15	494.01	6,030	....	626	2.34	14,100	....	U.S.G.S.	
4	June 19	6.76	492.62	5,330	....	619	2.04	10,900	....	U.S.G.S.	
	1921										
5	Aug. 1	5.64	491.50	4,540	....	561	1.82	8,270	....	U.S.G.S.	
	1922										
6	April 6	15.48	501.34	10,400	....	600	3.54	36,800	....	U.S.G.S.	
7	April 13	17.90	503.76	12,000	....	653	4.05	48,500	....	U.S.G.S.	
	1925										
8	April 3	7.60	493.46	5,751	13.5	589	2.20	12,675	F	S.D.C.	Meter submerged .6 of depth.
9	June 10	6.20	492.06	4,970	12.2	580	1.94	9,653	F	S.D.C.	Meter submerged .6 of depth.
10	June 16	6.20	492.06	4,970	12.2	580	1.89	9,576	F	S.D.C.	Meter submerged .6 of depth.

Note—Current meter measurements taken at Morris Highway Bridge.
"F" indicates falling river.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT OTTAWA, ILLINOIS.

Gauge readings refer to gauge on C., B. & Q. Railroad Bridge.

Elevation of zero gauge=453.90 Memphis Datum.

	1925										
1	April 2	6.00	459.90	4,144	15.1	597	4.03	16,685	R	S.D.C.	Meter submerged .6 of depth.
2	June 11	4.22	458.12	3,070	13.4	537	3.32	10,192	R	S.D.C.	Meter submerged .6 of depth.

NOTE—Current meter measurements taken at C., B. & Q. Railroad Bridge.
"R" indicates rising river.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT LA SALLE, ILLINOIS.

Gauge readings refer to gauge on LaSalle Highway Bridge.

Elevation of zero gauge=444.13 Memphis Datum.

	1925										
1	June 13	5.40	449.53	6,405	25.1	617	1.30	8,320	S	S.D.C.	Meter submerged .6 of depth.

NOTE—Current meter measurements taken at La Salle Highway Bridge.
"S" indicates stationary river.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER NEAR DEPUE, ILLINOIS.

Gauge readings refer to gauge on C., I. & S. Railroad Bridge.

Elevation of zero gauge=439.75 Memphis Datum.

	1925										
1	April 1	13.15	452.90	10,985	30.8	639	1.49	16,336	S	S.D.C.	Meter submerged 1 foot.
2	June 12	8.55	448.30	8,541	26.2	513	1.04	8,860	S	S.D.C.	Meter submerged .6 of depth.
3	June 23	8.80	448.55	8,287	26.5	539	1.19	9,888	S	S.D.C.	Meter submerged .6 of depth.

NOTE—Current meter measurements taken at C., I. & S. Railroad Bridge.
"S" indicates stationary river.
Where meter is submerged one foot the discharge in table is 90% of observed flow.

TABLE NO. B-4—Continued.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT CHILLICOTHE, ILLINOIS.

Gauge readings refer to gauge on Atchison, Topeka & Santa Fe Railroad Bridge.

Elevation of zero gauge =436.32 Memphis Datum.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1925										
1	June 15	10.40	446.72	7,231	15.6	865	1.48	10,681	F	S.D.C.	Meter submerged .6 of depth.
2	June 24	10.70	447.02	7,954	16.0	881	1.43	11,340	S	S.D.C.	Meter submerged .6 of depth.
	1927										
3	June 7	23.65	459.97	23,146	29.2	1,277	1.98	45,919	F	S.D.C.	Meter submerged 1 foot.
4	June 8	23.40	459.72	22,712	28.9	1,272	1.88	42,809	F	S.D.C.	Meter submerged 1 foot.
5	June 8	23.40	459.72	22,805	28.9	1,272	1.93	43,970	F	S.D.C.	Meter submerged 1 foot.
6	June 9	23.00	459.32	22,430	28.5	1,274	1.54	34,468	F	S.D.C.	Meter submerged 1 foot.
7	June 14	20.70	457.02	19,276	26.2	1,250	1.53	29,561	F	S.D.C.	Meter submerged 2 feet.
8	June 17	19.50	455.82	17,979	25.0	1,201	1.49	26,790	F	S.D.C.	Meter submerged .6 of depth.
9	June 20	18.35	454.67	16,658	23.9	1,170	1.32	22,032	F	S.D.C.	Meter submerged .6 of depth.
10	June 24	17.25	453.57	15,282	22.7	1,163	1.16	17,750	F	S.D.C.	Meter submerged .6 of depth.

Note—Current meter measurements taken at A., T. & S. F. Railroad Bridge.
"F" indicates falling river and "S" stationary.
Where meter was submerged one foot the discharge in table is 90% of observed flow.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT PEORIA, ILLINOIS.

Gauge readings refer to gauge on Lower Wagon Bridge at foot of Bridge Street.

Elevation of zero gauge—435.82 Memphis Datum.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1916										
1	June 27	17.45	453.27	11,400	....	747	2.70	30,700	....	U.S.G.S.	
2	Aug. 22	11.10	446.92	6,360	....	712	1.87	11,900	....	U.S.G.S.	
	1917										
3	Mar. 31	15.03	450.85	8,960	....	714	2.29	20,500	....	U.S.G.S.	
4	July 30	12.67	448.49	7,240	....	707	2.03	14,700	....	U.S.G.S.	
5	Oct. 16	10.68	446.50	5,950	....	694	1.78	10,600	....	U.S.G.S.	
	1918										
6	June 12	13.28	449.10	7,890	....	709	2.12	16,700	....	U.S.G.S.	
7	Aug. 23	10.60	446.42	5,990	....	694	1.80	10,800	....	U.S.G.S.	

	1919									
8	Mar. 29	21.20	457.02	13,700	------------	729	3.21	44,000	----------	U.S.G.S.
9	Aug. 7	10.27	446.09	5,880	------------	688	1.80	10,600	----------	U.S.G.S.
	1920									
10	April 3	20.62	456.44	13,500	------------	818	3.05	41,200	----------	U.S.G.S.
	1921									
11	Mar. 16	12.39	448.21	7,190	------------	706	1.96	14,100	----------	U.S.G.S.
	1922									
12	April 7	23.00	458.82	15,200	------------	748	3.20	48,700	----------	U.S.G.S.
13	April 15	24.80	460.62	16,100	------------	747	3.52	56,700	----------	U.S.G.S.
14	May 5	18.64	454.46	12,000	------------	729	2.35	28,200	----------	U.S.G.S.
15	May 12	16.67	452.49	10,500	------------	725	2.27	23,800	----------	U.S.G.S.
16	May 20	15.06	450.88	9,080	------------	721	2.22	20,100	----------	U.S.G.S.
	1923									
18	Apr. 24-25	13.65	449.97	8,170	------------	716	2.09	17,100	----------	U.S.G.S.
	1924									
19	Mar. 31	18.15	453.97	10,816	22.5	715	3.13	33,896	F	U.S.Engr.
20	April 2	19.2	455.02	11,399	22.2	727	3.42	38,963	R	U.S.Engr.
21	April 3	19.6	455.42	11,800	22.3	724	3.57	42,181	R	U.S.Engr.
22A	April 4	19.95	455.77	12,340	22.7	740	3.44	42,651	R	U.S.Engr.
22B	April 4	20.0	455.82	12,160	23.0	740	3.49	42,451	R	U.S.Engr.
23A	April 5	20.15	455.97	12,472	23.3	740	3.57	44,491	R	U.S.Engr.
23B	April 5	20.15	455.97	12,545	23.6	740	3.44	43,174	S	U.S.Engr.
24A	April 7	19.95	455.72	12,267	22.8	740	3.47	42,626	F	U.S.Engr.
24B	April 7	20.0	455.82	12,183	23.0	740	3.51	42,784	R	U.S.Engr.
25A	April 9	19.8	455.62	12,030	22.6	738	3.36	40,484	F	U.S.Engr.
25B	April 9	19.75	455.57	11,850	22.6	738	3.36	39,776	F	U.S.Engr.
26	April 10	19.5	455.32	11,758	22.4	734	3.18	37,374	F	U.S.Engr.
27A	April 11	19.3	455.12	11,568	22.0	734	3.21	37,124	F	U.S.Engr.
27B	April 11	19.3	455.12	11,576	22.0	734	3.21	37,142	F	U.S.Engr.
28A	April 14	18.55	454.37	11,086	21.6	732	3.13	34,672	F	U.S.Engr.
28B	April 14	18.55	454.37	11,117	21.6	732	3.07	34.128	F	U.S.Engr.
29A	April 15	18.3	454.12	10,844	21.3	730	3.00	32,566	F	U.S.Engr.
29B	April 15	18.25	454.07	10,797	21.2	730	2.95	31,897	F	U.S.Engr.
30	April 16	18.0	453.82	10,645	21.0	725	2.88	30,666	F	U.S.Engr.
31A	April 18	17.5	453.32	10,380	20.5	715	2.92	30,293	F	U.S.Engr.
31B	April 18	17.5	453.32	10,348	20.5	715	2.96	30,678	F	U.S.Engr.
32	April 19	17.3	453.12	10,177	20.2	713	2.91	29,638	F	U.S.Engr.
33A	April 21	16.9	452.72	9,800	19.8	700	2.73	26,794	F	U.S.Engr.
33B	April 21	16.85	452.57	9,796	19.8	700	2.71	26,748	F	U.S.Engr.
34A	April 22	16.75	452.57	9,713	19.8	700	2.84	27,592	F	U.S.Engr.
34B	April 22	16.75	452.57	9,691	19.8	700	2.83	27,430	F	U.S.Engr.
35A	April 25	16.1	451.92	9,359	19.2	692	2.65	24,814	F	U.S.Engr.
35B	April 25	16.2	452.02	9,337	19.2	692	2.71	25,352	R	U.S.Engr.
36	April 26	16.1	451.92	9,337	19.2	692	2.60	24,257	F	U.S.Engr.
37A	April 28	15.8	451.62	9,034	19.2	685	2.58	23,281	F	U.S.Engr.
37B	April 28	15.8	451.62	9,040	19.0	685	2.61	23,587	F	U.S.Engr.
38A	April 29	15.7	451.52	9,028	18.8	685	2.64	23,879	F	U.S.Engr.
38B	April 29	15.7	451.52	9,001	18.7	685	2.64	23,732	F	U.S.Engr.
39A	April 30	15.65	451.47	8,914	18.6	683	2.66	23,752	F	U.S.Engr.

TABLE NO. B-4—Continued.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1924										
39B	April 30	15.65	451.47	8,898	18.6	683	2.68	23,880	S	U.S.Engr.	
40A	May 1	15.5	451.32	8,633	18.5	678	2.70	23,303	F	U.S.Engr.	
40B	May 1	15.5	451.32	8,658	18.5	678	2.64	22,891	F	U.S.Engr.	
41A	May 2	15.4	451.22	8,565	18.4	674	2.62	22,349	F	U.S.Engr.	
41B	May 2	15.4	451.22	8,517	18.3	674	2.68	22,850	F	U.S.Engr.	
42A	May 3	15.3	451.12	8,530	18.2	674	2.60	22,186	F	U.S.Engr.	
42B	May 3	15.3	451.12	8,485	18.3	674	2.76	23,385	F	U.S.Engr.	
43	May 5	15.1	450.92	8,438	18.0	673	2.53	21,340	F	U.S.Engr.	
44A	May 6	15.0	450.82	8,349	18.0	670	2.50	20,887	F	U.S.Engr.	
44B	May 6	15.0	450.82	8,330	18.0	670	2.63	21,908	F	U.S.Engr.	
45A	May 8	14.9	450.72	8,261	17.7	670	2.47	20,488	F	U.S.Engr.	
45B	May 8	14.9	450.72	8,246	17.7	670	2.46	20,298	F	U.S.Engr.	
46A	May 10	14.7	450.52	8,002	17.4	665	2.54	20,319	F	U.S.Engr.	
46B	May 10	14.7	450.52	7,993	17.5	665	2.48	19,827	F	U.S.Engr.	
47A	May 13	14.55	451.37	7,886	17.4	665	2.46	19,424	F	U.S.Engr.	
47B	May 13	14.55	451.37	7,886	17.4	665	2.45	19,400	F	U.S.Engr.	
48A	May 15	14.5	451.32	7,900	17.3	665	2.44	19,302	F	U.S.Engr.	
48B	May 15	14.5	451.32	7,751	17.4	665	2.51	19,438	F	U.S.Engr.	
49A	May 16	14.45	450.27	7,888	17.3	665	2.40	18,923	F	U.S.Engr.	
49B	May 16	14.4	450.22	7,887	17.3	665	2.35	18,505	F	U.S.Engr.	
50A	May 21	14.1	449.92	7,679	16.9	665	2.41	18,492	F	U.S.Engr.	
50B	May 21	14.1	449.92	7,680	16.9	665	2.37	18,238	F	U.S.Engr.	
51A	May 24	13.85	449.67	7,517	16.7	658	2.34	17,572	F	U.S.Engr.	
51B	May 24	13.8	449.62	7,520	16.7	658	2.35	17,675	F	U.S.Engr.	
52A	May 27	13.6	449.42	7,254	16.4	648	2.40	17,402	F	U.S.Engr.	
52B	May 27	13.6	449.42	7,254	16.4	648	2.38	17,293	F	U.S.Engr.	
53	June 2	13.15	448.97	7,127	16.0	643	2.30	16,919	F	U.S.Engr.	
54	July 8	18.68	454.50	12,100	----------	737	2.58	31,200	---------	U.S.G.S.	
55	Aug. 22	20.5	456.32	12,200	26.5	715	3.34	40,616	R	U.S.Engr.	
56A	Aug. 26	20.6	456.42	12,053	23.7	730	2.77	33,969	F	U.S.Engr.	
56B	Aug. 26	20.6	456.42	11,594	23.6	730	2.86	33,306	F	U.S.Engr.	
	1925										
57A	Nov. 19	10.6	446.42	5 625	13.5	516	2.06	11,607	R	U.S.Engr.	
57B	Nov. 19	10.6	446.42	5,625	13.6	516	2.06	11,607	R	U.S.Engr.	
58A	Nov. 20	10.8	446.82	5,705	13.6	516	1.97	11,212	R	U.S.Engr.	
58B	Nov. 20	10.8	446.82	5,705	13.6	516	2.02	11,541	R	U.S.Engr.	
59A	Nov. 21	10.8	446.82	5,669	13.6	516	2.04	11,541	S	U.S.Engr.	
59B	Nov. 21	10.8	446.82	5,662	13.6	516	2.26	12,769	S	U.S.Engr.	
60A	Nov. 23	11.1	446.92	5,783	13.8	516	2.03	11,748	R	U.S.Engr.	
60B	Nov. 23	11.1	446.92	5,800	13.8	516	2.08	12,097	R	U.S.Engr.	
60C	Nov. 23	11.1	446.92	5,852	13.9	516	2.01	11,761	R	U.S.Engr.	

60D	Nov.	23	11.1	446.92	5,854	13.9	516	2.05	12,011	R	U.S.Engr.	
61A	Nov.	24	11.15	446.97	5,785	13.8	516	1.98	11,464	R	U.S.Engr.	
61B	Nov.	24	11.15	446.97	5,768	13.8	516	2.07	11,948	R	U.S.Engr.	
61C	Nov.	24	11.15	446.97	5,785	13.8	516	2.04	11,813	R	U.S.Engr.	
61D	Nov.	24	11.15	446.97	5,707	13.8	516	2.05	11,697	R	U.S.Engr.	
62A	Nov.	25	11.25	447.07	5,878	13.9	518	2.16	12,720	R	U.S.Engr.	
62B	Nov.	25	11.25	447.07	5,878	14.1	518	2.05	12,066	R	U.S.Engr.	
62C	Nov.	25	11.25	447.07	5,914	14.1	518	2.13	12,616	R	U.S.Engr.	
62D	Nov.	25	11.25	447.07	5,914	14.1	518	2.06	12,205	S	U.S.Engr.	
63A	Nov.	27	11.25	447.07	5,882	14.1	518	2.09	12,316	S	U.S.Engr.	
63B	Nov.	27	11.25	447.07	5,882	14.1	518	2.11	12,422	S	U.S.Engr.	
63C	Nov.	27	11.25	447.07	5,875	14.1	518	2.04	12,000	S	U.S.Engr.	
63D	Nov.	27	11.25	447.07	5,875	14.1	518	2.14	12,582	S	U.S.Engr.	
64A	Nov.	30	11.05	446.87	5,765	13.9	516	1.96	11,340	F	U.S.Engr.	
64B	Nov.	30	11.05	446.87	5,765	13.9	516	1.99	11,476	F	U.S.Engr.	
64C	Nov.	30	11.10	446.92	5,766	13.9	516	1.97	11,374	F	U.S.Engr.	
64D	Nov.	30	11.10	446.92	5,766	13.9	516	2.00	11,539	F	U.S.Engr.	
	1926											
65	April	20	19.40	455.22	12,400	----------	727	2.56	31,700	----------	U.S.G.S.	
66	Oct.	9	24.40	460.22	21,073	29.7	984	2.41	50,879	S	S.D.C.	*Meter submerged 1 foot.
67	Oct.	20	21.6	457.42	19,320	25.5	1,068	2.09	40,499	F	U.S.Engr.	
	1927											
68	April	25	24.4	460.22	23,596	28.5	1,068	2.69	63,500	F	U.S.Engr.	
69A	April	26	24.2	460.02	23,415	28.3	1,068	2.64	61,892	F	U.S.Engr.	
69B	April	26	24.2	460.02	23,402	28.4	1,068	2.66	62,207	F	U.S.Engr.	
70A	April	27	23.8	459.62	22,789	28.0	1,068	2.66	60,632	F	U.S.Engr.	
70B	April	27	23.8	459.62	22,500	27.8	1,068	2.64	59,298	F	U.S.Engr.	
71	April	27	23.88	459.70	15,900	----------	762	3.28	52,200	----------	U.S.G.S.	
72A	May	28	23.3	459.12	22,843	28.0	1,068	3.06	69,913	F	U.S.Engr.	
72B	May	28	23.7	459.52	22,779	28.0	1,068	3.06	69,649	R	U.S.Engr.	

NOTE—All current meter measurements, except U.S.G.S., were taken at the P. & P. U. Railroad Bridge. U.S.G.S current meter measurements were taken at Peoria Lower Wagon Bridge.

"F" indicates falling river, "R" rising and "S" stationary river.

* This gauge reading was taken at the P. & P. U. Railroad Bridge. Discharge in table is 90% of observed flow.

TABLE NO. B-4—Continued.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT HAVANA, ILLINOIS.

Gauge readings refer to gauge on Havana Highway Bridge.

Elevation of zero gauge=431.93 Memphis Datum.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1922										
1	April 6	18.98	450.91	13,900	....	708	3.29	45,700	....	U.S.G.S.	
2	Apr. 17-18	22.26	454.19	20,500	....	8,460	3.10	63,500	....	U.S.G.S.	
3	April 29	20.28	452.21	15,300	....	777	3.21	49,200	....	U.S.G.S.	
4	May 9	16.44	448.37	12,200	....	762	2.94	35,600	....	U.S.G.S.	
5	May 16	14.31	446.24	10,400	....	703	2.71	28,200	....	U.S.G.S.	
6	May 17	14.13	446.06	10,100	....	702	2.64	27,400	....	U.S.G.S.	
7	May 25	12.78	444.71	9,390	....	705	2.57	24,100	....	U.S.G.S.	
8	May 25	12.77	444.70	9,370	....	705	2.53	23,700	....	U.S.G.S.	
9	June 8	12.60	444.53	9,170	....	703	2.60	23,800	....	U.S.G.S.	
10	June 29	9.60	441.53	7,260	....	553	2.05	14,900	....	U.S.G.S.	
11	Oct. 19	7.67	438.60	6,100	....	530	1.72	10,500	....	U.S.G.S.	
	1926										
12	Sept. 19	19.31	451.24	13,833	35.1	713	2.77	38,322	R	S.D.C.	* Meter submerged 1 foot.
13	Sept. 23	18.39	450.32	13,166	34.2	713	2.57	33,892	F	S.D.C.	* Meter submerged 1 foot.
14	Sept. 29	18.51	450.44	13,410	34.3	713	3.51	47,046	R	S.D.C.	* Meter submerged 1 foot.
15	Sept. 30	18.64	450.47	13,469	34.5	713	3.63	48,848	R	S.D.C.	* Meter submerged 1 foot.
16	Oct. 1	18.93	450.86	13,716	34.8	713	3.70	50,742	R	S.D.C.	* Meter submerged 1 foot.
17	Oct. 2	19.49	451.42	14,018	35.3	713	3.63	50,867	R	S.D.C.	* Meter submerged 1 foot.
18	Oct. 3	20.05	451.98	14,446	35.9	713	3.43	49,528	R	S.D.C.	* Meter submerged 1 foot.
19	Oct. 5	21.50	453.43	17,493	37.4	4,853	3.19	53,114	R	S.D.C.	* Meter submerged 1 foot.
20	Oct. 8	22.19	454.12	22,406	38.1	5,933	2.94	53,013	R	S.D.C.	* Meter submerged 1 foot.
21	Oct. 10	22.65	454.58	26,254	38.5	8,316	2.40	52,278	R	S.D.C.	* Meter submerged 1 foot.
22	Oct. 11	23.00	454.93	30,331	38.8	9,236	2.67	63,254	R	S.D.C.	* Meter submerged 1 foot.
23	Oct. 13	23.13	455.06	31,658	38.9	9,236	2.54	61,037	S	S.D.C.	* Meter submerged 1 foot.
24	Oct. 14	23.03	454.96	28,611	38.8	9,074	2.73	55,827	F	S.D.C.	* Meter submerged 1 foot.
25	Oct. 16	22.60	454.53	26,285	38.4	8,316	2.79	57,847	F	S.D.C.	* Meter submerged 1 foot.
26	Oct. 20	21.00	452.93	15,066	36.8	1,167	3.15	47,296	F	S.D.C.	* Meter submerged 1 foot.
	1927										
27	May 10	18.70	450.37	14,518	33.5	774	3.56	51,697	F	U.S.Engr.	Mean of 2.
28	May 3	20.70	452.37	15,884	34.1	774	4.03	63,858	F	U.S.Engr.	Mean of 2.
29	June 6	21.60	453.27	16,576	35.0	774	4.00	66,226	R	U.S.Engr.	Mean of 2.

NOTE—All current meter measurements were taken at the Havana Highway Bridge.
"F" indicates falling river, "R" rising river and "S" stationary river.
* Discharges in table are 90% of observed flow.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT BEARDSTOWN, ILLINOIS.

Gauge readings refer to gauge on Chicago, Burlington & Quincy Railroad Bridge.

Elevation of zero gauge=427.25 Memphis Datum.

	1921										
1	Mar.	14	9.28	....	10,300	....	1,001	1.52	15,700	....	U.S.G.S.	
2	April	13	10.70	....	11,800	....	1,027	1.77	20,900	....	U.S.G.S.	
3	April	23	11.84	....	12,900	....	1,036	1.71	22,100	....	U.S.G.S.	
4	May	3	14.57	....	15,600	....	1,036	2.19	34,200	....	U.S.G.S.	
5	Aug.	1	8.07	....	9,030	....	981	1.19	10.700	....	U.S.G.S.	
6	Dec.	2	13.37	440.62	14,500	....	1,038	2.12	30,700	....	U.S.G.S.	
	1922											
7	April	3	19.62	446.87	20,960	....	1,038	2.45	51,300	....	U.S.G.S.	
8	April	8	22.00	449.25	24,100	....	2,038	2.81	67,800	....	U.S.G.S.	
9	May	26	13.45	440.70	14,500	....	1,040	2.02	29,300	....	U.S.G.S.	
10	July	26	8.87	436.12	9,910	....	992	1.37	13,600	....	U.S.G.S.	
11	Oct.	20	8.09	435.34	8,880	....	980	1.23	10,900	....	U.S.G.S.	
	1923											
12	April	27	10.90	438.15	11,900	....	1,047	1.79	21,300	....	U.S.G.S.	
	1924											
13	April	10	17.49	444.74	18,700	....	1,037	2.82	52,700	....	U.S.G.S.	
14	July	9	17.93	445.18	19,200	....	1,044	2.58	49,500	....	U.S.G.S.	
	1925											
14½	Oct.	31	8.35	435.60	9,210	....	990	1.29	11,900	....	U.S.G.S.	
15	Sept.	17	22.11	449.36	24,400	....	2,040	2.83	69,100	....	U.S.G.S.	
	1926											
16	Sept.	20	22.24	449.49	26,225	28.4	1,591	2.78	65,752	F	S.D.C.	* Meter submerged 1 foot.
17	Sept.	22	21.81	449.06	26,042	28.0	1,590	2.64	61,275	F	S.D.C.	* Meter submerged 1 foot.
18	Sept.	24	21.15	448.40	23,982	27.3	1,589	2.69	59,818	F	S.D.C.	* Meter submerged 1 foot.
19	Sept.	25	20.77	448.02	21,820	27.0	1,038	2.68	58,574	F	S.D.C.	* Meter submerged 1 foot.
20	Sept.	27	20.40	447.65	21,408	26.7	1,038	2.74	58,623	S	S.D.C.	* Meter submerged 1 foot.
21	Sept.	28	20.45	447.60	21,493	26.7	1,038	2.72	58,487	R	S.D.C.	* Meter submerged 1 foot.
22	Sept.	29	20.60	447.85	21,646	26.9	1,038	2.76	59,683	R	S.D.C.	* Meter submerged 1 foot.
23	Sept.	30	20.80	448.05	21,878	27.1	1,038	2.66	58,277	R	S.D.C.	* Meter submerged 1 foot.
24	Oct.	1	21.21	448.46	22,312	27.5	1,038	2.52	56,155	R	S.D.C.	* Meter submerged 1 foot.
25	Oct.	2	21.78	449.03	26,098	28.1	1,589	2.47	58,232	R	S.D.C.	* Meter submerged 1 foot.
26	Oct.	3	22.60	449.85	28,312	28.9	1,597	2.35	58,364	R	S.D.C.	* Meter submerged 1 foot.
27	Oct.	4	23.25	450.50	29,772	29.6	1,614	2.43	62,081	R	S.D.C.	* Meter submerged 1 foot.
28	Oct.	5	24.17	451.42	31,724	30.4	1,660	2.46	66,820	R	S.D.C.	* Meter submerged 1 foot.
29	Oct.	6	24.66	451.91	32,421	30.9	3,161	2.64	73,809	R	S.D.C.	* Meter submerged 1 foot.
30	Oct.	7	25.70	452.95	41,204	31.7	5,824	2.66	70,396	F	S.D.C.	* Meter submerged 1 foot.
31	Oct.	8	25.38	452.63	41,561	31.5	5,552	3.09	90,843	R	S.D.C.	* Meter submerged 1 foot.
32	Oct.	9	26.05	453.30	38,811	32.2	5,716	3.20	96,054	R	S.D.C.	* Meter submerged 1 foot.
33	Oct.	10	26.11	453.36	38,321	32.3	5,701	2.69	80,683	R	S.D.C.	* Meter submerged 1 foot.
34	Oct.	11	26.28	453.53	39,057	32.4	5,601	2.56	77,352	R	S.D.C.	* Meter submerged 1 foot.
35	Oct.	12	26.36	453.61	38,075	32.6	5,701	2.48	74,923	S	S.D.C.	* Meter submerged 1 foot.
36	Oct.	13	26.30	453.55	38,286	32.4	5,696	2.54	77,012	F	S.D.C.	* Meter submerged 1 foot.

TABLE NO. B-4—Continued.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1926										
37	Oct. 14	26.14	453.39	41,634	32.3	5,701	2.56	79,550	F	S.D.C.	* Meter submerged 1 foot.
38	Oct. 15	25.92	453.17	40,498	32.0	5,595	2.47	75,502	F	S.D.C.	* Meter submerged 1 foot.
39	Oct. 16	25.55	452.80	38,148	31.7	5,522	2.60	77,186	F	S.D.C.	* Meter submerged 1 foot.
40	Oct. 17	25.22	452.47	36,854	31.3	5,482	2.54	74,210	F	S.D.C.	* Meter submerged 1 foot.
41	Oct. 18	24.80	452.05	35,468	30.9	5,340	2.60	72,872	F	S.D.C.	* Meter submerged 1 foot.
42	Oct. 19	24.37	451.62	33,956	30.5	5,330	2.56	70,528	F	S.D.C.	* Meter submerged 1 foot.
	1927										
43	April 26	25.10	452.35	36,949	31.4	5,504	2.66	78,003	R	S.D.C.	* Meter submerged 1 foot.
44	April 28	25.04	452.29	39,529	31.3	5,418	2.67	79,558	F	S.D.C.	* Meter submerged 1 foot.
44A	April 28	25.00	452.25	39,700	------------	4,650	2.20	87,600	----------	U.S.G.S.	
44B	June 10	24.58	451.83	39,400	------------	4,660	2.22	87,400	----------	U.S.G.S.	
45	May 4	23.2	450.45	26,312	29.2	1,086	2.98	81,258	F	U.S.Engr.	Mean of 2.
46	May 7	22.0	449.25	26,230	28.0	1,086	2.96	76,165	F	U.S.Engr.	
47	May 9	21.5	448.75	24,369	27.5	1,086	2.89	71,082	F	U.S.Engr.	
48	June 1	24.5	451.75	27,692	30.7	1,086	3.38	93,917	R	U.S.Engr.	Mean of 2.
49	June 3	24.4	451.65	27,278	31.7	1,086	3.21	90,875	R	U.S.Engr.	Mean of 2.

NOTE—All current meter measurements were taken at the Beardstown Highway Bridge.
"F" indicates falling river, "R" rising river and "S" stationary.
* S.D.C. discharges in table are 90% of observed flow.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT PEARL, ILLINOIS.

Gauge readings refer to gauge on Chicago & Alton Railroad Bridge.

Elevation of zero gauge=419.70 Memphis Datum.

No.	Date.	Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1926										
1	Sept. 19	18.60	438.50	19,243	25.1	1,064	3.67	70,599	S	S.D.C.	*Meter submerged 1 foot.
2	Sept. 20	18.60	438.30	19,386	25.1	1,064	3.75	72,732	S	S.D.C.	*Meter submerged 1 foot.
3	Sept. 21	18.55	438.20	19,172	25.0	1,064	3.70	70,945	F	S.D.C.	*Meter submerged 1 foot.
4	Sept. 22	18.40	438.10	19,074	24.9	1,064	3.82	72,318	F	S.D.C.	*Meter submerged 1 foot.
5	Sept. 23	18.20	437.90	18,869	24.7	1,063	3.60	67,886	F	S.D.C.	*Meter submerged 1 foot.
6	Sept. 24	17.90	437.60	18,460	24.3	1,062	3.77	69,543	F	S.D.C.	*Meter submerged 1 foot.
7	Sept. 25	17.90	437.60	18,558	24.4	1,062	3.74	69,394	F	S.D.C.	*Meter submerged 1 foot.
8	Sept. 26	17.70	437.40	18,443	24.2	1,062	3.55	65,470	F	S.D.C.	*Meter submerged 1 foot.
9	Sept. 27	17.65	437.35	18,556	24.2	1,062	3.55	65,868	R	S.D.C.	*Meter submerged 1 foot.
10	Sept. 28	17.90	437.60	18,669	24.5	1,063	3.46	64,674	R	S.D.C.	*Meter submerged 1 foot.

11	Sept.	29	18.10		18,773	24.6	1,062	3.47	65,097	R	S.D.C.	*Meter submerged 1 foot.
12	Sept.	30	18.30		19,010	24.9	1,062	3.37	64,143	R	S.D.C.	*Meter submerged 1 foot.
13	Oct.	1	19.00		19,259	25.7	1,064	3.40	67,791	R	S.D.C.	*Meter submerged 1 foot.
14	Oct.	2	20.40		21,638	27.2	1,066	3.49	75,559	R	S.D.C.	*Meter submerged 1 foot.
15	Oct.	3	21.32		22,251	27.9	1,070	3.30	73,514	R	S.D.C.	*Meter submerged 1 foot.
16	Oct.	4	21.60		22,506	28.1	1,070	3.22	72,476	R	S.D.C.	*Meter submerged 1 foot.
17	Oct.	5	21.80		22,925	28.4	1,070	3.35	76,900	R	S.D.C.	*Meter submerged 1 foot.
18	Oct.	6	22.00		22,929	28.5	1,070	3.37	77,183	F	S.D.C.	*Meter submerged 1 foot.
19	Oct.	7	22.00		22,930	28.5	1,070	3.42	78,353	F	S.D.C.	*Meter submerged 1 foot.
20	Oct.	8	21.70		22,453	28.1	1,070	3.35	75,129	F	S.D.C.	*Meter submerged 1 foot.
21	Oct.	9	21.50		22,406	28.0	1,068	3.47	77,803	R	S.D.C.	*Meter submerged 1 foot.
22	Oct.	10	21.60		22,501	28.1	1,068	3.51	79,018	S	S.D.C.	*Meter submerged 1 foot.
23	Oct.	11	21.60		22,442	28.1	1,068	3.79	84,966	F	S.D.C.	*Meter submerged 1 foot.
24	Oct.	12	21.50		22,427	28.0	1,068	3.70	83,029	S	S.D.C.	*Meter submerged 1 foot.
25	Oct.	13	21.50		22,436	28.0	1,068	3.92	87,966	F	S.D.C.	*Meter submerged 1 foot.
26	Oct.	14	21.35		22,215	27.8	1,068	3.92	87,162	F	S.D.C.	*Meter submerged 1 foot.
27	Oct.	15	21.20		22,196	27.7	1,068	3.89	86,258	F	S.D.C.	*Meter submerged 1 foot.
28	Oct.	16	21.00		21,616	27.4	1,068	3.96	85,490	F	S.D.C.	*Meter submerged 1 foot.
29	Oct.	17	20.70		21,474	27.1	1,068	3.95	84,732	F	S.D.C.	*Meter submerged 1 foot.
30	Oct.	18	20.30		21,073	26.7	1,074	4.02	84,763	F	S.D.C.	*Meter submerged 1 foot.
	1927											
31	May	5	19.30	439.00	23,989	27.2	1,140	4.70	112,597		U.S.Engr.	
32	May	6	19.10	438.80	23,754	27.0	1,140	4.68	110,987		U.S.Engr.	
33	April	21	21.55	441.25					81,150		Caldwell Engr. Co.	
34	April	28	22.48	442.18					95,250		Caldwell Engr. Co.	
35	May	3	20.03	439.73	21,800			4.16	91,300		Caldwell Engr. Co.	
36	May	16	17.10	436.80					67,300		Caldwell Engr. Co.	
37	June	16	20.62	440.32					87,560		Caldwell Engr. Co.	
38	June	30	14.55	434.25					55,200		Caldwell Engr. Co.	

NOTE—All current meter measurements were taken at the Chicago & Alton Railroad Bridge.
"F" indicates falling river, "R" rising river and "S" stationary.
* S.D.C. discharges are 90% of observed flow.

TABLE NO. B-4—Concluded.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT HARDIN, ILLINOIS.

Gauge readings refer to gauge 1,200 feet north of ferry landing.
Elevation of zero gauge=419.70 Memphis Datum.

No.	Date.		Gauge reading, feet.	Water surface elevation, feet.	Area of section, square feet.	Maximum depth, feet.	Width, feet.	Mean velocity, second-feet.	Discharges, C.F.S.	Status of river.	Authority.	Remarks.
	1926											
1	Sept.	28	13.85	434.55	26,003	----------	----------	2.83	74,294	R	U.S.Engr.	
2	Sept.	29	13.85	433.55	26,304	----------	----------	2.80	73,765	R	U.S.Engr.	
3	Sept.	30	14.65	434.35	26,955	----------	----------	2.75	74,023	R	U.S.Engr.	
4	Oct.	1	15.20	434.90	28,197	----------	----------	2.88	81,143	R	U.S.Engr.	
5	Oct.	2	16.08	435.78	29,570	----------	----------	3.04	89,406	R	U.S.Engr.	Mean of 2.
6	Oct.	4	18.05	437.75	32,461	----------	----------	3.05	97.978	R	U.S.Engr.	
7	Oct.	5	18.40	438.10	32,701	----------	----------	3.22	105,604	R	U.S.Engr.	
8	Oct.	6	18.60	438.30	32,506	----------	----------	3.23	104,990	S	U.S.Engr.	Crest of flood. Mean of 3.
9	Oct.	7	18.55	438.25	32,395	----------	----------	3.14	101.548	F	U.S.Engr.	
10	Oct.	8	18.24	437.94	32,702	----------	----------	2.98	97,586	F	U.S.Engr.	Mean of 2.
11	Oct.	9	17.80	437.50	31,724	----------	----------	2.73	86,740	F	U.S.Engr.	
12	Oct.	11	17.12	436.82	30,856	----------	----------	2.92	91,041	F	U.S.Engr.	
13	Oct.	14	16.48	436.18	29,765	----------	----------	2.63	75,313	F	U.S.Engr.	
14	Oct.	18	14.78	434.48	26,962	----------	----------	3.36	90,453	F	U.S.Engr.	
15	Oct.	20	14.02	433.72	26.341	----------	----------	4.20	110,635	F	U.S.Engr.	
16	Oct.	25	12.42	432.12	23,744	----------	----------	3.55	84,102	F	U.S.Engr.	
17	Oct.	27	11.78	431.48	22,706	----------	----------	4.11	84,855	F	U.S.Engr.	
18	Oct.	29	11.10	430.80	20,947	----------	----------	3.22	67,292	F	U.S.Engr.	
19	Nov.	11	10.08	429.78	19,790	----------	----------	3.04	60,209	F	U.S.Engr.	Mean of 2.
20	Nov.	3	9.30	429.00	18,848	----------	----------	2.94	55,562	F	U.S.Engr.	Mean of 2.
21	Nov.	5	8.68	428.38	17,994	----------	----------	2.88	51,750	F	U.S.Engr.	Mean of 2.
22	Nov.	10	7.30	427.00	16,139	----------	----------	2.65	43,783	F	U.S.Engr.	Mean of 2.

NOTE—Current meter measurements taken 1,200 feet north of ferry landing.
"F" indicates falling river, "R" rising river and "S" stationary.

DISCHARGE MEASUREMENTS OF ILLINOIS RIVER AT REICH'S FERRY.

(Mile 83.9 from mouth of river.)

Gauge readings refer to temporary gauge at Reich's Ferry Landing.

Elevation of zero gauge=434.15 Memphis Datum.

	1926										
1	Sept. 18	14.00	....	22,766	33.00	1,000	3.71	84,395	S	U.S.Engr.	Mean of 2.
2	Sept. 20	14.00	....	22,273	32.30	995	3.69	82,178	S	U.S.Engr.	Mean of 2.
3	Sept. 21	13.80	....	22,601	31.80	985	3.69	83,375	F	U.S.Engr.	Mean of 2.
4	Sept. 22	13.57	....	21,946	31.30	970	3.38	74,051	F	U.S.Engr.	Mean of 2.
5	Sept. 23	13.22	....	21,622	31.20	955	3.38	73,134	F	U.S.Engr.	Mean of 2.
6	Sept. 25	12.62	....	21,581	31.10	945	3.17	68,890	F	U.S.Engr.	Mean of 2.

NOTE—Current meter measurements taken at Reich's Ferry Landing at .2 and .8 of the depth.
"F" indicates falling river and "S" stationary.

TABLE NO. B-5.

FLOW CONDITIONS DURING DISCHARGE MEASUREMENTS.
By Sanitary District of Chicago.

Station.	Date.	Stations.		Conditions.
		From—	To—	
	1926			
Beardstown	9—20	0+00	1+40	Taken on lower side of bridge as upper side was filled with logs.
Beardstown	9—22	0+00	1+20	Taken on lower side of bridge as upper side was filled with logs.
Beardstown	9—22	7+80	on	Had trouble with meter, had to adjust four or five times.
Beardstown	9—24	----------	----------	Some float. Reading taken from upstream side of bridge.
Beardstown	9—30	0+07	0+20	Lower chord under water.
Beardstown	10—1	0+03.5	0+10	Lower chord under water.
Beardstown	10—2	0+03.5	0+70	Lower chord under water.
Beardstown	10—2	1+00	----------	Drift.
Beardstown	10—2	1+40	----------	Drift at protection piling.
Beardstown	10—3	0+03.5	0+30	Lower chord under water.
Beardstown	10—3	0+00	1+45	Taken from downstream side of bridge.
Beardstown	10—3	10+50	----------	Lower chord under water.
Beardstown	10—4	0+30	1+40	Drift on upstream side of bridge. Due to high water all readings were taken on downstream side of bridge, except at draw span, which was taken from a boat.
Beardstown	10—4	4+54	6+58	Lower chord under water.
Beardstown	10—4	6+62	----------	Heavy upstream wind all P. M.
Beardstown	10—4	10+60	----------	Drift on upstream face of bridge.
Beardstown	10—5	0+10	0+20	Heavy drift on upstream side of bridge, readings taken on downstream side.
Beardstown	10—5	1+00	1+10	Heavy drift on upstream side of bridge.
Beardstown	10—5	4+54	----------	Wind heavy upstream P. M.
Beardstown	10—5	7+40	----------	Water over lower chord.
Beardstown	10—6	10+75	----------	Heavy drift on upstream side of bridge. Wind S. W. 108 rev. per min. at 9 A. M.
Beardstown	10—7	1+00	1+10	Heavy drift on upstream side of bridge.
Beardstown	10—7	0+75	----------	Edge of water on deck.
Beardstown	10—7	----------	----------	Readings taken from upstream side of bridge on East approach to draw.
Beardstown	10—9	0+00	1+10	No wind. Measurements taken from upstream face of bridge.
Beardstown	10—10	10+65	----------	Edge of water top of bridge deck. Four inches of water over top of deck, end of bridge.
Beardstown	10—11	----------	----------	Light downstream wind. Measurements taken from upstream side of bridge.
Beardstown	10—12	0+00 to	Coal Cre	ek levee. No current.
		0+80	0+70	No wind. Log.
Beardstown	10—12	2+50	----------	Edge of current.
	----------	5+20	----------	Steel interference.
	----------	5+60	----------	Drift interference.
	----------	9+00	----------	Wind 90 rev. per min.
Beardstown	10—14	9+10	10+80	Measurements taken 3 feet out from upstream side of bridge.
Beardstown	10—14	0+00	1+00	Water on deck of bridge.
Beardstown	10—15	0+00	0+85	Water on bridge deck. Measurements taken 3 feet out from upstream side of bridge.
Beardstown	10—15	8+00	----------	Drift interference.
Beardstown	10—16	0+00	0+65	Water on deck of bridge. Measurements taken 3 feet out from face of upstream side of bridge.
Beardstown	10—17	0+00	0+55	Water on deck of bridge.
Beardstown	10—18	0+00	0+30	Strong north wind. Water on deck of bridge.
	1927			
Beardstown	4—26	----------	----------	Section along hard road heavy south wind.
Beardstown	4—28	0+00	0+50	Water on deck of bridge.
	----------	5+70		Heavy gusty.
	----------	8+30	--------	Downstream wind. Section along hard road heavy S. E. wind.
	1926			
Havana	9—23	0+78	----------	Beginning of logs on surface.
Havana	9—29	0+10	1+50	Log interference.
Havana	9—30	0+00	2+20	Logs in river influence current.
Havana	10—1	0+00	1+93	Metered on lower side of bridge due to logs and drift on upper side.
Havana	10—2	0+00	1+92	Metered on lower side due to logs.
Havana	10—3	----------	----------	Cook's levee broke last night and probably filling, which causes slowness of current.

TABLE NO. B-5—Concluded.

FLOW CONDITIONS DURING DISCHARGE MEASUREMENTS.
By Sanitary District of Chicago.

Station.	Date.	Stations. From—	Stations. To—	Conditions.
Havana	10—5	0+00	2+00	Metered on lower side of bridge.
Havana	10—8	0+00	2+00	Metered on lower side of bridge.
Havana	10—10			Chautauqua levee broke 7 A. M. Believe that break affected this measurement as current increased as time went on.
Havana	10—10	0+00	2+00	Metered on lower side of bridge on account of logs on upper side.
Havana	10—11	0+00	2+00	Metered on downstream side of bridge. Logs influenced readings out to Station 2+30.
Havana	10—13	0+00	2+00	Metered on downstream side of bridge.
Havana	10—14	0+00 2+30	2+00	Metered on downstream side of bridge. Logs affect current this far. Wind begins to effect readings.
Havana	10—16	0+00	2+00	Readings downstream side of bridge.
Havana	10—20	1+19	1+92.4	Readings downstream side of bridge.
	1926			
Oakford	10—4			Measurement taken under difficult conditions, as levees were breaking and water pouring into districts and covering highways.
Beardstown Havana Oakford				References to light winds and rains and other conditions not affecting current omitted in tabulation.

TABLE NO. B-6.

RATING DIAGRAM DISCHARGE AT PEORIA.

Observation No.	Group.	Date.	Authority.	Elevation of water surface. Peoria.	Elevation of water surface. Pekin.	Total fall.	Discharge. Observed.	Discharge. Diagram.	Residual = Diagram minus observed. C. F. S.	Residual = Diagram minus observed. %
		1916								
1	K	June 27	U. S. G. S.	453.21	451.17	2.04	30,700	30,200	— 500	— 1.6
2	R	Aug. 22	U. S. G. S	446.86	444.77	2.09	11,900	11,500	— 400	— 3.4
		1917								
3	N	Mar. 31	U. S. G. S.	450.79	448.57	2.27	20,500	21,800	+1,300	+ 5.9
4	Q	July 30	U. S. G. S.	448.43	446.20	2.23	14,700	15,100	+ 400	+ 2.6
5	R	Oct. 16	U. S. G. S.	446.44	444.17	2.27	10,600	12,000	+1,400	+11.7
		1918								
6	P	June 12	U. S. G. S.	449.04	446.87	2.17	16,700	16,100	— 500	— 3.1
*7		Aug. 23	U. S. G. S.	446.36	444.02	2.29	10,800	11,500	+ 700	+ 6.1
		1919								
8	E	Mar. 29	U. S. G. S.	456.96	454.92	2.04	44,000	45,700	+1,700	+ 3.7
9	R	Aug. 7	U. S. G. S.	446.03	443.87	2.17	10,600	10,500	— 100	+ 1.0
		1920								
10	E	Apr. 3	U. S. G. S.	456.38	454.07	2.31	41,200	45,700	+4,500	+ 9.8
		1921								
11	Q	Mar. 16	U. S. G. S.	448.15	445.92	2.23	14,100	15,100	+1,000	+ 6.6
		1922								
12	C	Apr. 7	U. S. G. S.	458.82	456.85	1.97	48,700	53,900	+5,200	+ 9.6
13	A	Apr. 15	U. S. G. S.	460.62	459.10	1.52	56,700	56,000	— 700	— 1.2
14	I	May 5	U. S. G. S.	454.46	453.05	1.41	28,200	29,200	+1,000	+ 3.4
15	L	May 12	U. S. G. S.	452.49	450.82	1.67	23,800	24,500	+ 700	+ 2.8
16	N	May 20	U. S. G. S.	450.88	448.45	2.03	20,100	20,900	+ 800	+ 3.8
		1923								
18	O	Apr. 24	U. S. G. S.	449.67	447.36	2.31	17,100	18,500	+1,400	+ 7.6
		1924								
19	J	Mar. 31	U. S. Engrs.	453.97	451.97	2.00	33,900	32,600	—1,300	— 4.0
20	H	Apr. 2	U. S. Engrs.	455.02	452.87	2.15	38,960	38,400	— 560	— 1.5
21	G	Apr. 3	U. S. Engrs.	455.42	453.17	2.25	42,180	41,100	—1,080	— 2.6
22	G	Apr. 4	U. S. Engrs.	455.79	453.55	2.24	42,550	42,700	+ 150	+ 0.3
23	G	Apr. 5	U. S. Engrs.	455.97	453.77	2.20	43,830	43,000	— 830	— 1.9

TABLE NO. B-6—Continued.

RATING DIAGRAM DISCHARGE AT PEORIA.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Peoria.	Pekin.		Observed.	Diagram.	C. F. S.	%
		1916								
24	G	Apr. 7	U. S. Engrs.	455.79	453.82	1.97	42,710	39,700	—3,010	— 7.6
25	G	Apr. 9	U. S. Engrs.	455.59	453.62	1.97	40,130	38,900	—2,230	— 5.7
26	H	Apr. 10	U. S. Engrs.	455.32	453.32	2.00	37,380	38,100	+ 720	+ 1.9
27	H	Apr. 11	U. S. Engrs.	455.12	453.10	2.02	37,130	39,500	+2,370	+ 6.0
28	J	Apr. 14	U. S. Engrs.	454.37	452.37	2.00	34,400	34,300	— 100	— 2.9
29	J	Apr. 15	U. S. Engrs.	454.00	452.17	1.83	32,230	31,300	— 930	— 3.0
30	J	Apr. 16	U. S. Engrs.	453.82	451.80	2.08	30,670	32,300	+1,530	+ 4.7
31	K	Apr. 18	U. S. Engrs.	453.32	451.37	1.95	30,440	29,600	— 840	— 2.8
32	K	Apr. 19	U. S. Engrs.	453.12	451.07	2.05	29,640	29,700	+ 60	+ 0.2
33	L	Apr. 21	U. S. Engrs.	452.70	450.72	1.98	26,770	27,300	+ 530	+ 1.7
34	L	Apr. 22	U. S. Engrs.	452.57	450.52	2.05	27,510	27,500	— 10	0.0
35	M	Apr. 25	U. S. Engrs.	451.97	449.90	2.07	25,080	25,400	+ 320	+ 1.2
36	M	Apr. 26	U. S. Engrs.	451.92	449.85	2.07	24,260	25,200	+ 940	+ 3.7
37	M	Apr. 28	U. S. Engrs.	451.62	449.57	2.05	23,430	23,800	+ 370	+ 1.5
38	M	Apr. 29	U. S. Engrs.	451.52	449.52	2.00	23,810	23,100	— 710	— 3.1
39	M	Apr. 30	U. S. Engrs.	451.47	449.47	2.00	23,770	22,900	— 870	— 3.8
40	M	May 1	U. S. Engrs.	451.32	449.32	2.00	23,100	22,300	— 800	— 3.6
41	M	May 2	U. S. Engrs.	451.22	449.20	2.02	22,600	22,000	— 600	— 2.7
42	M	May 3	U. S. Engrs.	451.12	449.05	2.07	22,790	22,000	— 790	— 3.6
43	N	May 5	U. S. Engrs.	450.92	448.87	2.05	21,340	21,200	— 140	— 0.7
44	N	May 6	U. S. Engrs.	450.82	448.77	2.05	21,400	20,800	— 600	— 2.9
45	N	May 8	U. S. Engrs.	450.72	448.72	2.00	20,390	20,300	— 90	— 0.4
46	N	May 10	U. S. Engrs.	450.52	448.47	2.05	20,070	19,800	— 270	— 1.3
47	N	May 13	U. S. Engrs.	450.37	448.27	2.10	19,410	19,600	+ 190	+ 1.0
48	N	May 15	U. S. Engrs.	450.32	448.17	2.15	19,370	19,600	+ 230	+ 1.2
49	N	May 16	U. S. Engrs.	450.24	448.12	2.12	18,710	19,300	+ 590	+ 3.1
50	O	May 21	U. S. Engrs.	449.92	447.80	2.12	18,370	18,300	— 70	— 0.4
51	O	May 24	U. S. Engrs.	449.64	447.52	2.12	17,620	17,500	— 120	— 0.7
52	O	May 27	U. S. Engrs.	449.42	447.32	2.10	17,350	17,000	— 350	— 2.1
53	P	June 2	U. S. Engrs.	448.97	446.97	2.00	16,420	15,500	— 920	— 5.9
54	I	July 8	U. S. G. S.	454.15	452.67	1.48	31,200	29,500	—1,700	— 5.8
55	F	Aug. 22	U. S. Engrs.	456.32	454.57	1.75	40,620	39,400	—1,220	— 3.1
56	F	Aug. 26	U. S. Engrs.	456.42	454.97	1.45	33,640	36,400	+2,760	+ 7.6
		1925								
57	R	Nov. 19	U. S. Engrs.	446.42	444.17	2.25	11,610	11,300	— 310	— 2.7
58	R	Nov. 20	U. S. Engrs.	446.62	444.32	2.30	11,380	12,000	+ 620	+ 5.2
59	R	Nov. 21	U. S. Engrs.	446.62	444.37	2.25	12,160	11,700	— 460	— 3.9
60	R	Nov. 23	U. S. Engrs.	446.92	444.65	2.27	11,910	12,500	+ 590	+ 4.7
61	R	Nov. 24	U. S. Engrs.	446.97	444.47	2.50	11,730	14,000	+2,270	+16.2
62	R	Nov. 25	U. S. Engrs.	447.07	444.65	2.42	12,400	13,000	+ 600	+ 4.6
63	R	Nov. 27	U. S. Engrs.	447.07	444.75	2.32	12,330	12,500	+ 170	+ 1.3
64	R	Nov. 30	U. S. Engrs.	446.90	444.50	2.40	11,430	12,500	+1,070	+ 8.5
		1926								
65	H	Apr. 20	U. S. G. S.	455.22	453.45	1.77	31,700	35,300	+3,600	+10.2
		Sept. 28	------------	456.92	455.27	1.65	--------	40,700	----------	------
		Sept. 29	------------	457.12	455.42	1.70	--------	42,300	----------	------
		Sept. 30	------------	457.32	455.57	1.75	--------	43,700	----------	------
		Oct. 1	------------	457.42	455.77	1.57	--------	41,800	----------	------
		Oct. 2	------------	457.82	456.40	1.42	--------	41,300	----------	------
		Oct. 3	------------	458.22	456.90	1.32	--------	41,600	----------	------
		Oct. 4	------------	458.62	457.52	1.10	--------	39,500	----------	------
		Oct. 5	------------	459.52	458.37	1.15	--------	44,000	----------	------
		Oct. 6	------------	460.12	458.57	1.55	--------	54,200	----------	------
		Oct. 7	------------	460.42	†(458.82)	†(1.60)	--------	†(56,500)	----------	------
		Oct. 8	------------	460.72	†(459.07)	†(1.65)	--------	†(58,800)	----------	------
66	A	Oct. 9	S. D. C.	‡460.22	459.32	1.50	50,880	56,600	+5,720	+10.1
		Oct. 10	------------	460.72	459.15	1.57	--------	57,400	----------	------
		Oct. 11	------------	460.52	459.17	1.35	--------	52,400	----------	------
		Oct. 12	------------	460.42	459.00	1.42	--------	53,200	----------	------
		Oct. 13	------------	460.12	458.87	1.25	--------	48,600	----------	------
		Oct. 14	------------	459.72	458.57	1.15	--------	44,900	----------	------
		Oct. 15	------------	459.42	458.20	1.22	--------	45,000	----------	------
		Oct. 16	------------	458.92	457.87	1.05	--------	39,700	----------	------
		Oct. 17	------------	458.52	457.42	1.10	--------	39,100	----------	------
		Oct. 18	------------	458.12	457.02	1.10	--------	37,500	----------	------
		Oct. 19	------------	458.02	456.62	1.40	--------	41,900	----------	------

TABLE NO. B-6—Concluded.

RATING DIAGRAM DISCHARGE AT PEORIA.

Observation No.	Group.	Date.	Authority.	Elevation of water surface. Peoria.†	Pekin.	Total fall.	Discharge. Observed.	Diagram.	Residual = Diagram minus observed. C. F. S.	%
		1926								
67	D	Oct. 20	U. S. Engrs.	457.42	456.20	1.22	40,500	36,900	—3,600	— 9.8
		Oct. 21	-------------	456.92	455.65	1.27	--------	35,800	----------	-----
		Oct. 22	-------------	456.32	455.25	1.07	--------	30,900	----------	-----
		Oct. 23	-------------	456.12	454.82	1.30	--------	33,500	----------	-----
		Oct. 24	-------------	455.82	454.52	1.30	--------	32,500	----------	-----
		Oct. 25	-------------	455.32	454.07	1.25	--------	30,200	----------	-----
		Oct. 26	-------------	454.92	453.67	1.25	--------	28,800	----------	-----
		Oct. 27	-------------	454.42	453.22	1.20	--------	26,600	----------	-----
		Oct. 28	-------------	454.12	452.82	1.30	--------	26,800	----------	-----
		Oct. 29	-------------	453.82	452.52	1.30	--------	25,800	----------	-----
		Oct. 30	-------------	453.52	452.22	1.30	--------	25,200	----------	-----
		Oct. 31	-------------	453.12	451.77	1.35	--------	24,200	----------	-----
	1927									
		Apr. 18	-------------	455.42	454.02	1.40	--------	32,300	----------	-----
		Apr. 19	-------------	456.22	454.87	1.35	--------	34,400	----------	-----
		Apr. 20	-------------	457.42	455.97	1.45	--------	40,200	----------	-----
		Apr. 21	-------------	458.82	457.47	1.35	--------	44,800	----------	-----
		Apr. 22	-------------	459.82	458.17	1.65	--------	52,700	----------	-----
		Apr. 23	-------------	460.22	458.57	1.65	--------	56,300	----------	-----
		Apr. 24	-------------	460.22	458.57	1.65	--------	56,300	----------	-----
68	B	Apr. 25	U. S. Engrs.	460.22	458.40	1.82	63,500	59,200	—4,300	— 7.3
69	B	Apr. 26	U. S. Engrs.	460.02	458.12	1.90	62,050	59,500	—2,550	— 4.3
70	B	Apr. 27	U. S. Engrs.	459.62	457.92	1.70	59,960	58,300	—1,660	— 2.9
71	B	Apr. 27	U. S. G. S.	459.70	457.92	1.78	52,200	57,200	+5,000	+ 8.7
		Apr. 28	-------------	459.02	457.57	1.45	--------	47,200	----------	-----
		Apr. 29	-------------	458.82	457.27	1.55	--------	47,800	----------	-----
		Apr. 30	-------------	458.72	457.17	1.55	--------	47,400	----------	-----
		May 1	-------------	458.52	456.97	1.55	--------	46,400	----------	-----
		May 2	-------------	458.62	456.87	1.75	--------	49,700	----------	-----
		May 3	-------------	458.52	456.77	1.75	--------	49,300	----------	-----
		May 4	-------------	458.12	456.52	1.60	--------	45,400	----------	-----
		May 5	-------------	457.82	456.22	1.60	--------	44,100	----------	-----
		May 6	-------------	457.52	455.87	1.65	--------	43,400	----------	-----
		May 7	-------------	457.22	455.52	1.70	--------	42,700	----------	-----
		May 8	-------------	457.02	455.07	1.95	--------	44,900	----------	-----
		May 9	-------------	456.02	454.57	1.45	--------	34,900	----------	-----
		May 10	-------------	455.72	454.32	1.40	--------	33,200	----------	-----
		May 11	-------------	455.82	454.42	1.40	--------	33,600	----------	-----
		May 12	-------------	455.82	454.22	1.60	--------	35,800	----------	-----
		May 13	-------------	455.32	453.92	1.40	--------	31,900	----------	-----
		May 14	-------------	455.12	453.67	1.45	--------	31,600	----------	-----
72	B	May 28	U. S. Engrs.	459.52	457.87	1.65	69,780	52,700	—17,080	—32.3
		June 1	-------------	458.72	457.12	1.60	--------	48,100	----------	-----
		June 2	-------------	458.42	456.77	1.65	--------	47,400	----------	-----
		June 3	-------------	458.22	456.67	1.55	--------	45.000	----------	-----
		June 4	-------------	458.12	456.97	1.15	--------	38,400	----------	-----
		June 5	-------------	458.82	457.47	1.35	--------	44,700	----------	-----
		June 6	-------------	459.22	457.87	1.35	--------	46,400	----------	-----
		June 7	-------------	459.42	457.87	1.55	--------	50,600	----------	-----
		June 8	-------------	459.22	457.67	1.55	--------	49,700	----------	-----
		June 9	-------------	458.82	457.37	1.45	--------	46,300	----------	-----
		June 10	-------------	458.42	456.87	1.55	--------	46,000	----------	-----
		June 11	-------------	458.12	456.52	1.60	--------	45,400	----------	-----
		June 12	-------------	457.82	456.47	1.35	--------	40,400	----------	-----

* Not used in construction of diagram.
† Gauge not read at Pekin, elevations were interpolated.
‡ Peoria gauge read at lower wagon bridge.

TABLE NO. B-7.

RATING DIAGRAM DISCHARGE AT HAVANA.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Havana.	Bath.		Observed.	Diagram.	C. F. S.	%
		1922								
1	F	Apr. 6	U. S. G. S.	450.91	449.46	1.45	45,700	49,800	+ 4,100	+ 8.3
*2	B	Apr. 17 and 18	U. S. G. S.	454.19	452.67	1.52	63,500	75,000	+11,500	+15.3
3	E	Apr. 29	U. S. G. S.	452.21	451.11	1.10	49,200	50,200	+ 1,000	+ 2.0
4	G	May 9	U. S. G. S.	448.37	447.26	1.11	35,600	33,800	— 1,800	— 5.3
5	H	May 16	U. S. G. S.	446.24	444.81	1.43	28,200	29,000	+ 800	+ 2.7
6	H	May 17	U. S. G. S.	446.06	444.46	1.60	27,400	29,600	+ 2,200	+ 7.4
7	I	May 25	U. S. G. S.	444.71	443.00	1.71	24,100	24,400	+ 300	+ 1.2
8	I	May 25	U. S. G. S.	444.70	443.01	1.65	23,700	24,000	+ 300	+ 1.2
9	I	June 8	U. S. G. S.	444.53	442.76	1.77	23,800	24,000	+ 200	+ 0.8
10	J	June 29	U. S. G. S.	441.59	439.96	1.63	14,900	15,300	+ 400	+ 2.6
11	K	Sept. 19	U. S. G. S.	439.60	438.16	1.44	10,500	10,300	— 200	— 1.9
		1926								
12	F	Sept. 19	S. D. C.	451.24	450.46	0.78	38,320	38,400	+ 80	+ 0.2
13	F	Sept. 23	S. D. C.	450.30	449.56	0.74	33,890	33,800	— 90	— 0.3
		Sept. 28	----	450.36	448.96	1.40	----	46,400	----	----
14	F	Sept. 29	S. D. C.	450.45	449.06	1.39	47,050	46,600	— 450	— 1.0
15	F	Sept. 30	S. D. C.	450.60	449.31	1.29	48,850	45,800	— 3,050	— 6.7
16	F	Oct. 1	S. D. C.	450.93	449.56	1.37	50,740	48,800	— 1,940	— 4.0
17	F	Oct. 2	S. D. C.	451.47	450.21	1.26	50,870	49,600	— 1,270	— 2.6
18	E	Oct. 3	S. D. C.	452.06	450.86	1.20	49,530	52,100	+ 2,570	+ 4.9
		Oct. 4	----	452.66	451.46	1.20	----	55,900	----	----
*19	C	Oct. 5	S. D. C.	453.48	452.31	1.17	53,110	60,300	+ 7,190	+11.9
		Oct. 6	----	453.56	452.66	0.90	----	54,200	----	----
		Oct. 7	----	453.86	453.36	0.50	----	42,300	----	----
*20	B	Oct. 8	S. D. C.	454.18	453.46	0.72	53,010	53,400	+ 390	+ 0.7
		Oct. 9	----	454.76	453.96	0.80	----	62,800	----	----
*21	B	Oct. 10	S. D. C.	454.62	454.01	0.61	52,280	54,000	+ 1,720	+ 3.2
		1926								
22	A	Oct. 11	S. D. C.	454.95	454.26	0.69	63,250	60,600	— 2,650	— 4.3
		Oct. 12	----	455.06	454.36	0.70	----	62,400	----	----
23	A	Oct. 13	S. D. C.	455.06	454.31	0.75	61,040	64,300	+ 3,260	+ 5.1
24	A	Oct. 14	S. D. C.	454.95	454.16	0.79	55,830	64,600	+ 8,770	+13.6
		Oct. 15	----	454.86	453.96	0.93	----	67,400	----	----
25	B	Oct. 16	S. D. C.	454.50	453.66	0.84	57,850	61,400	+ 3,550	+ 5.8
		Oct. 17	----	454.16	453.36	0.80	----	56,100	----	----
		Oct. 18	----	453.86	452.96	0.90	----	56,600	----	----
		Oct. 19	----	453.46	452.56	0.90	----	53,400	----	----
26	D	Oct. 20	S. D. C.	452.89	451.96	0.93	47,300	51,900	+ 4,600	+ 8.9
		Oct. 21	----	452.56	451.56	1.00	----	49,800	----	----
		Oct. 22	----	451.96	451.16	0.80	----	42,100	----	----
		Oct. 23	----	451.56	450.46	1.10	----	46,900	----	----
		Oct. 24	----	451.16	450.26	0.90	----	40,600	----	----
		Oct. 25	----	450.76	449.86	0.90	----	39,000	----	----
		Oct. 26	----	450.36	449.36	1.00	----	39,500	----	----
		Oct. 27	----	449.96	448.96	1.00	----	38,000	----	----
		Oct. 28	----	449.56	448.56	1.00	----	36,500	----	----
		Oct. 29	----	449.06	448.16	0.90	----	32,500	----	----
		Oct. 30	----	448.76	447.76	1.00	----	33,400	----	----
		Oct. 31	----	448.36	447.36	1.00	----	31,900	----	----
		1927								
		Apr. 18	----	450.46	449.76	0.70	----	32,900	----	----
		Apr. 19	----	450.96	450.06	0.90	----	39,700	----	----
		Apr. 20	----	451.46	450.56	0.90	----	41,900	----	----
		Apr. 21	----	452.06	451.06	1.00	----	47,100	----	----
		Apr. 22	----	452.76	451.66	1.10	----	54,000	----	----
		Apr. 23	----	453.26	452.26	1.00	----	55,000	----	----
		Apr. 24	----	453.66	452.76	0.90	----	55,000	----	----
		Apr. 25	----	453.86	453.06	0.80	----	53,400	----	----
		Apr. 26	----	453.96	453.26	0.70	----	51,000	----	----
		Apr. 27	----	453.96	453.26	0.70	----	51,000	----	----
		Apr. 28	----	453.76	453.06	0.70	----	49,200	----	----
		Apr. 29	----	453.56	452.86	0.70	----	47,800	----	----
		Apr. 30	----	453.36	452.56	0.80	----	49,500	----	----
		May 1	----	453.16	452.36	0.80	----	48,400	----	----
		May 2	----	452.96	452.06	0.90	----	49,700	----	----
27	L	May 3	U. S. Eng.	452.76	451.61	1.15	63,860	55,400	— 8,460	—15.3
		May 4	----	452.46	451.36	1.10	----	52,000	----	----
		May 5	----	452.06	451.06	1.00	----	47,200	----	----
		May 6	----	451.76	450.66	1.10	----	47,900	----	----

TABLE NO. B-7—Concluded.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Havana.	Bath.		Observed.	Diagram.	C. F. S.	%
		May 7	--------------	451.36	450.26	1.10	--------	46,000	----------	------
		May 8	--------------	451.06	449.96	1.10	--------	44,600	----------	------
		May 9	--------------	450.86	449.66	1.20	--------	46,000	----------	------
28	M	May 10	U. S. Eng.	450.76	449.61	1.15	51,700	44,200	— 7,500	—16.9
		May 11	--------------	450.56	449.36	1.20	--------	44,300	----------	------
		May 12	--------------	450.36	449.16	1.20	--------	43,300	----------	------
		May 13	--------------	450.16	448.96	1.20	--------	42,300	----------	------
		June 2	--------------	453.16	452.46	0.70	--------	42,500	----------	------
		June 3	--------------	453.16	452.36	0.80	--------	48,400	----------	------
		June 4	--------------	453.06	452.46	0.60	--------	41,200	----------	------
		June 5	--------------	453.16	452.66	0.50	--------	38,400	----------	------
29	N	June 6	U. S. Eng.	453.56	452.81	0.80	66,230	50,800	—15,430	—30.4
		June 7	--------------	453.56	452.96	0.60	--------	44,300	----------	------
		June 8	--------------	453.76	453.06	0.70	--------	49,200	----------	------
		June 9	--------------	453.66	452.96	0.70	--------	48,400	----------	------
		June 10	--------------	453.36	452.76	0.60	--------	43,000	----------	------
		June 11	--------------	453.06	452.36	0.70	--------	44,800	----------	------
		June 12	--------------	452.96	452.26	0.70	--------	44,300	----------	------

* Not used in construction of diagram.

TABLE NO. B-8.

MEASURED AND RATING DIAGRAM DISCHARGES AT BEARDSTOWN.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Beardstown.	La-Grange.		Observed.	Diagram.	C. F. S.	%
		1921								
1	N	Mar. 14	U.S.G.S.	436.53	435.58	0.95	15,700	15,200	— 500	— 3.3
2	O	Apr. 13	U.S.G.S.	437.95	436.60	1.35	20,900	20,600	— 300	— 1.4
3	D	Apr. 23	U.S.G.S.	439.09	437.55	1.54	22,100	24,800	+ 2,700	+10.9
4	E	May 3	U.S.G.S.	441.82	439.90	1.92	34,200	34,800	+ 600	+ 1.7
5	M	Aug. 1	U.S.G.S.	435.32	434.61	0.71	10,700	11,200	+ 500	+ 4.5
6	G	Dec. 2	U.S.G.S.	440.62	438.91	1.71	30,700	29,800	— 900	— 3.0
		1922								
7	F	Apr. 3	U.S.G.S.	446.87	444.53	2.34	51,300	54,300	+ 3,000	+ 5.5
8	K	Apr. 8	U.S.G.S.	449.25	446.60	2.65	67,800	68,000	+ 200	+ .29
9	G	May 26	U.S.G.S.	440.70	438.98	1.32	29,300	26,400	— 2,900	—11.0
10	N	July 26	U.S.G.S.	436.12	435.18	0.94	13,600	14,300	+ 700	+ 4.9
11	M	Oct. 20	U.S.G.S.	435.34	434.73	0.61	10,900	10,300	— 600	— 5.8
		1923								
12	O	Apr. 27	U.S.G.S.	438.15	436.58	1.57	21,300	22,800	+ 1,500	+ 6.6
		1924								
13	H	Apr. 10	U.S.G.S.	444.74	442.43	2.31	52,700	46,800	— 5,900	—12.6
14	H	July 9	U.S.G.S.	445.18	443.03	2.15	49,500	46,600	— 2,900	— 6.2
		1925								
14½		Oct. 31	U.S.G.S.	435.60	No record	--------	11,900	----------	----------	--------
		1926								
15	K	Sept. 17	U.S.G.S.	449.36	446.83	2.53	69,100	67,000	— 2,100	— 3.1
16	K	Sept. 20	S. D. C.	449.45	446.86	2.59	65,750	68,000	+ 2,250	+ 3.3
17	J	Sept. 22	S. D. C.	448.99	446.55	2.44	61,270	64,000	+ 2,730	+ 4.3
18	I	Sept. 24	S. D. C.	448.33	445.98	2.35	59,820	58,500	— 1,320	— 2.2
19	I	Sept. 25	S. D. C.	447.98	445.65	2.33	58,570	57,300	— 1,270	— 2.2
20	I	Sept. 27	S. D. C.	447.65	445.23	2.42	58,680	58,400	— 280	— .48
21	I	Sept. 28	S. D. C.	447.72	445.30	2.42	58,230	58,500	+ 270	+ .52
22	I	Sept. 29	S. D. C.	447.87	445.45	2.42	56,160	59,200	+ 3,040	+ 5.1
23	I	Sept. 30	S. D. C.	448.10	445.60	2.50	58,230	60,600	+ 2,370	+ 3.9
24	J	Oct. 1	S. D. C.	448.53	446.23	2.30	58,160	60,400	+ 2,240	+ 3.7
25	J	Oct. 2	S. D. C.	449.14	447.05	2.09	58,230	59,800	+ 1,570	+ 2.6
26	L	Oct. 3	S. D. C.	449.89	447.83	2.06	58,360	63,600	+ 5,240	+ 8.3
27	L	Oct. 4	S. D. C.	450.63	448.33	2.30	62,880	69,000	+ 6,120	+ 8.9
28	*A	Oct. 5	S. D. C.	451.51	448.78	2.70	66,820	78,600	+11,780	+15.0

TABLE NO. B-8—Concluded.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Beardstown.	LaGrange.		Observed.	Diagram.	C. F. S.	%
		1926								
29	*A	Oct. 6	S. D. C.	452.03	448.91	3.12	73,810	87,000	+13,190	+15.2
30	*B	Oct. 7	S. D. C.	452.80	449.51	3.29	79,400	93,000	+13,600	+14.6
31	*B	Oct. 8	S. D. C.	452.68	448.85	3.83	90,840	99,600	+ 8,760	+ 8.8
32	*B	Oct. 9	S. D. C.	453.33	449.50	3.83	96,050	103,200	+ 7,150	+ 6.9
33	*C	Oct. 10	S. D. C.	453.40	450.05	3.35	80,680	97,000	+ 6,320	+ 6.5
34	*C	Oct. 11	S. D. C.	453.56	450.23	3.33	77,350	97,600	+20,250	+20.7
35	*C	Oct. 12	S. D. C.	453.60	450.33	3.27	74,920	97,000	+22,080	+22.8
36	*C	Oct. 13	S. D. C.	453.54	450.33	3.21	77,010	96,000	+18,990	+19.8
37	*C	Oct. 14	S. D. C.	453.37	450.18	3.19	79,550	94,400	+14,850	+15.7
38	*B	Oct. 15	S. D. C.	453.12	450.08	3.04	75,500	91,000	+15,500	+17.1
39	*B	Oct. 16	S. D. C.	452.77	449.81	2.96	77,190	88,100	+10,910	+12.4
40	*A	Oct. 17	S. D. C.	452.43	449.63	2.80	72,210	84,100	+11,890	+14.1
41	*A	Oct. 18	S. D. C.	452.01	449.23	2.78	72,870	81,800	+ 8,930	+10.9
42	*A	Oct. 19	S. D. C.	451.55	448.85	2.70	70,530	78,800	+ 8,270	+10.5
		Oct. 20	------------	451.14	448.46	2.68	--------	76,600	----------	-------
		Oct. 21	------------	450.65	448.08	2.57	--------	72,900	----------	-------
		Oct. 22	------------	450.17	447.63	2.54	--------	70,600	----------	-------
		Oct. 23	------------	449.70	447.23	2.47	--------	67,600	----------	-------
		Oct. 24	------------	449.25	446.83	2.42	--------	65,100	----------	-------
		Oct. 25	------------	448.75	446.38	2.37	--------	62,300	----------	-------
		Oct. 26	------------	448.30	445.96	2.34	--------	59,900	----------	-------
		Oct. 27	------------	447.85	445.53	2.32	--------	58,200	----------	-------
		Oct. 28	------------	447.43	445.16	2.27	--------	55,400	----------	-------
		Oct. 29	------------	446.98	444.76	2.22	--------	53,300	----------	-------
		Oct. 30	------------	446.55	444.38	2.17	--------	51,400	----------	-------
		Oct. 31	------------	446.13	443.98	2.15	--------	49,500	----------	-------
		1927								
		Apr. 18	------------	449.17	446.93	2.14	--------	60,800	----------	-------
		Apr. 19	------------	449.43	447.03	2.40	--------	65,400	----------	-------
		Apr. 20	------------	449.95	447.43	2.52	--------	69,400	----------	-------
		Apr. 21	------------	450.40	447.83	2.57	--------	71,800	----------	-------
		Apr. 22	------------	450.89	448.03	2.86	--------	78,100	----------	-------
		Apr. 23	------------	451.52	448.38	3.14	--------	84,600	----------	-------
		Apr. 24	------------	452.02	448.83	3.19	--------	87,600	----------	-------
		Apr. 25	------------	452.29	449.13	3.15	--------	88,600	----------	-------
43	*A	Apr. 26	S. D. C.	452.35	449.28	3.07	78,000	87,800	+ 9,800	+11.2
		Apr. 27	------------	452.45	449.38	3.07	--------	87,200	----------	-------
44	*A	Apr. 28	S. D. C.	452.26	449.38	2.88	79,560	84,600	+ 5,040	+ 6.4
44½	A	Apr. 28	U.S.G.S.	452.26	449.38	2.88	87,600	84,600	— 3,000	— 3.6
		Apr. 29	------------	452.17	449.33	2.84	--------	83,300	----------	-------
		Apr. 30	------------	451.88	449.08	2.80	--------	81,800	----------	-------
		May 1	------------	451.55	448.88	2.67	--------	78,400	----------	-------
		May 2	------------	451.20	448.58	2.62	--------	76,300	----------	-------
		May 3	------------	450.87	448.18	2.69	--------	75,500	----------	-------
45	L	May 4	U. S. Eng.	450.40	447.75	2.65	81,260	73,100	— 8,160	—11.1
		May 5	------------	450.15	447.53	2.62	--------	71,600	----------	-------
		May 6	------------	449.77	447.18	2.59	--------	69,400	----------	-------
46	K	May 7	U. S. Eng.	449.30	446.78	2.52	76,160	66,600	— 9,560	—14.4
		May 8	------------	449.07	446.58	2.49	--------	64,800	----------	-------
47	J	May 9	U. S. Eng.	448.75	446.33	2.42	71,080	62,900	+ 8,180	+13.0
		May 10	------------	448.47	446.28	2.19	--------	58,600	----------	-------
		May 11	------------	448.37	445.98	2.39	--------	60,600	----------	-------
		May 12	------------	448.15	445.73	2.42	--------	60,400	----------	-------
		May 13	------------	447.95	445.53	2.42	--------	59,600	----------	-------
48	A	June 1	U. S. Eng.	451.75	448.63	3.12	93,980	85,200	— 8,780	—10.3
		June 2	------------	451.75	448.63	3.12	--------	85,200	----------	-------
49	A	June 3	U. S. Eng.	451.65	448.68	2.97	90,760	82,800	— 7,960	— 9.6
		June 4	------------	451.68	448.78	2.90	--------	82,200	----------	-------
		June 5	------------	451.81	448.88	2.93	--------	83,200	----------	-------
		June 6	------------	451.95	448.88	3.07	--------	85,700	----------	-------
		June 7	------------	452.13	448.98	3.15	--------	87,700	----------	-------
		June 8	------------	452.25	449.08	3.17	--------	88,700	----------	-------
		June 9	------------	452.20	449.18	3.02	--------	86,400	----------	-------
44B	A	June 10	U.S.G.S.	451.85	449.04	2.81	87,400	81,700	— 5,700	— 7.0
		June 11	------------	451.63	448.83	2.80	--------	80,500	----------	-------
		June 12	------------	451.45	448.68	2.77	--------	79,200	----------	-------

* Not used in construction of diagram.

NOTE.—Observation Nos. 26 to 42 were made while levees were breaking and districts filling and emptying, and the discharge measurements during that period show the greatest departure from the diagram.

TABLE NO. B-9.

RATING DIAGRAM DISCHARGE AT PEARL.

Observation No.	Group.	Date.	Authority.	Elevation of water surface: Valley City.	Elevation of water surface: Pearl.	Total fall.	Discharge: Observed.	Discharge: Diagram.	Residual = Diagram minus observed: C. F. S.	Residual = Diagram minus observed: %
		1926								
1	D	Sept. 19	S. D. C.	444.00	438.30	5.70	70,600	74,800	+ 4,200	+ 5.6
2	D	Sept. 20	S. D. C.	444.04	438.30	5.74	72,730	75,200	+ 2,470	+ 3.3
3	D	Sept. 21	S. D. C.	443.98	438.22	5.76	70,940	75,000	+ 4,060	+ 5.4
4	D	Sept. 22	S. D. C.	443.77	438.05	5.72	72,820	73,600	+ 780	+ 1.1
5	D	Sept. 23	S. D. C.	443.48	437.85	5.63	67,890	71,600	+ 3,710	+ 5.2
6	D	Sept. 24	S. D. C.	443.17	437.53	5.60	69,540	69,700	+ 160	+ 0.2
7	E	Sept. 25	S. D. C.	442.96	437.55	5.41	69,390	67,600	— 1,790	— 2.7
8	E	Sept. 26	S. D. C.	442.67	437.35	5.32	65,470	65,200	— 270	— 0.4
9	E	Sept. 27	S. D. C.	442.58	437.37	5.21	65,870	64,500	— 1,370	— 2.1
10	E	Sept. 28	S. D. C.	442.71	437.65	5.06	64,670	64,200	— 470	— 0.7
11	E	Sept. 29	S. D. C.	442.85	437.77	5.08	65,100	64,900	— 200	— 0.3
12	E	Sept. 30	S. D. C.	443.06	438.12	4.94	64,140	64,900	+ 760	+ 1.2
13	D	Oct. 1	S. D. C.	443.87	438.90	4.97	67,790	68,800	+ 1,010	+ 1.5
14	C	Oct. 2	S. D. C.	445.08	440.35	4.73	75,560	73,300	— 2,260	— 3.1
15	C	Oct. 3	S. D. C.	445.67	441.07	4.62	73,510	75,400	+ 1,890	+ 2.5
16	C	Oct. 4	S. D. C.	446.00	441.32	4.68	72,480	77,500	+ 5,020	+ 6.5
17	B	Oct. 5	S. D. C.	446.44	441.54	4.91	76,900	81,600	+ 4,700	+ 5.8
18	B	Oct. 6	S. D. C.	446.50	441.65	4.82	77,180	81,300	+ 3,120	+ 3.8
19	B	Oct. 7	S. D. C.	446.77	441.67	5.10	78,350	84,900	+ 4,650	+ 5.5
20	B	Oct. 8	S. D. C.	446.15	441.31	4.84	75,130	79,900	+ 4,770	+ 6.0
21	B	Oct. 9	S. D. C.	446.69	441.21	5.48	77,800	87,300	+ 9,500	+10.9
22	A	Oct. 10	S. D. C.	447.19	441.30	5.89	79,020	93,200	+14,180	+15.2
23	A	Oct. 11	S. D. C.	447.44	441.29	6.15	85,970	94,800	+ 9,830	+10.4
24	A	Oct. 12	S. D. C.	447.46	441.20	6.26	83,030	96,000	+12,970	+12.5
25	A	Oct. 13	S. D. C.	447.44	441.17	6.27	87,970	97,200	+ 9,230	+ 9.4
26	A	Oct. 14	S. D. C.	447.42	441.01	6.41	87,160	98,400	+11,240	+11.4
27	A	Oct. 15	S. D. C.	447.29	440.85	6.44	86,260	97,900	+11,640	+11.9
28	A	Oct. 16	S. D. C.	447.08	440.60	6.48	85,490	97,000	+11,510	+11.9
29	B	Oct. 17	S. D. C.	446.75	440.32	6.43	84,730	94,900	+10,170	+10.7
30	B	Oct. 18	S. D. C.	446.42	439.90	6.52	84,760	93,400	+ 8,640	+ 9.3
		Oct. 19		446.12	439.70	6.42		91,100		
		Oct. 20		445.75	439.40	6.35		95,500		
		Oct. 21		445.33	439.00	6.33		86,100		
		Oct. 22		444.96	438.70	6.26		83,600		
		Oct. 23		444.54	438.40	6.14		79,800		
		Oct. 24		444.16	438.10	6.06		77,800		
		Oct. 25		443.70	437.80	5.90		74,400		
		Oct. 26		443.01	437.40	5.61		69,100		
		Oct. 27		442.83	437.10	5.73		69,000		
		Oct. 28		442.50	436.70	5.80		67,700		
		Oct. 29		442.08	436.40	5.68		65,100		
		Oct. 30		441.67	436.10	5.57		62,700		
		Oct. 31		441.20	435.70	5.50		60,500		
		1927								
		Apr. 18		444.78	441.1	3.68		63,300		
		Apr. 19		445.15	441.0	4.15		68,000		
		Apr. 20		445.50	441.1	4.40		72,800		
33	C	Apr. 21	*C. E. Co.	445.75	441.3	4.45	81,150	74,400	— 6,650	— 8.9
		Apr. 22		445.90	441.4	4.50		75,500		
		Apr. 23		446.25	441.4	4.85		80,200		
		Apr. 24	*C. E. Co.	446.70	441.8	4.90		83,000		
		Apr. 25		447.05	442.2	4.85		84,300		
		Apr. 26		447.4	442.4	5.00		87,300		
		Apr. 27		447.6	442.4	5.20		90,100		
34	A	Apr. 28	*C. E. Co.	447.65	442.2	5.45	95,250	92,200	— 3,050	— 3.3
		Apr. 29		447.5	441.9	5.60		92,700		
		Apr. 30		447.2	441.5	5.70		91,300		
		May 1		446.75	441.0	5.75		89,700		
		May 2		446.50	440.5	6.00		90,200		
35	C	May 3	*C. E. Co.	445.90	440.0	5.90	91,300	86,300	— 5,000	— 5.8
		May 4		445.55	439.5	6.05		85,400		
†31		May 5	U. S. Engrs.	445.05	439.2	5.85	112,600	81,500	—31,100	—38.2
†32		May 6	U. S. Engrs.	444.67	438.8	5.87	110,990	79,600	—31,390	—39.4
		May 7		444.40	438.5	5.90		78,300		
		May 8		444.20	438.6	5.60		75,100		
		May 9		443.90	438.6	5.30		71,400		
		May 10		443.85	438.6	5.25		70,900		

TABLE NO. B-9—Concluded.

RATING DIAGRAM DISCHARGE AT PEARL.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Valley City.	Pearl.		Observed.	Diagram.	C. F. S.	%
		1927								
		May 11	--------	443.70	438.4	5.30	--------	70,900	--------	-----
		May 12	--------	443.35	438.1	5.25	--------	68,300	--------	-----
		May 13	--------	443.05	437.8	5.25	--------	66,800	--------	-----
		May 14	--------	442.75	437.6	5.15	--------	64,700	--------	-----
36	E	May 16	*C. E. Co.	442.12	436.8	5.32	67,300	63,300	— 4,000	— 5.9
		June 1	--------	446.35	440.6	5.75	--------	87,600	--------	-----
		June 2	--------	446.45	440.5	5.95	--------	89,500	--------	-----
		June 3	--------	446.40	440.4	6.00	--------	89,600	--------	-----
		June 4	--------	446.65	(No reading.)	--------	--------	--------	--------	-----
		June 5	--------	446.65	440.6	6.05	--------	91,400	--------	-----
		June 6	--------	446.65	440.8	5.85	--------	90,000	--------	-----
		June 7	--------	446.70	440.9	5.80	--------	89,800	--------	-----
		June 8	--------	446.90	441.2	5.70	--------	90,400	--------	-----
		June 9	--------	447.10	441.4	5.70	--------	91,300	--------	-----
		June 10	--------	447.00	441.3	5.70	--------	90,900	--------	-----
		June 11	--------	446.70	441.0	5.70	--------	89,200	--------	-----
		June 12	--------	446.65	440.7	5.95	--------	90,500	--------	-----
37	C	June 16	*C. E. Co.	445.83	440.4	5.43	87,560	82,800	— 4,760	— 5.8
38	F	June 30	*C. E. Co.	439.67	434.4	5.27	55,200	54,100	— 1,100	— 2.0

* Caldwell Engineering Company.
† Not used in construction of diagram.

TABLE NO. B-10.

RATING DIAGRAM DISCHARGE AT HARDIN.

Observation No.	Group.	Date.	Authority.	Elevation of water surface.		Total fall.	Discharge.		Residual = Diagram minus observed.	
				Kampsville.	Grafton.		Observed.	Diagram.	C. F. S.	%
		1926								
1	H	Sept. 28	U. S. Engrs.	435.45	429.39	6.06	74,294	70,000	— 4,294	— 6.13
2	H	Sept. 29	U. S. Engrs.	435.72	430.09	5.63	73,765	69,800	— 3,965	— 5.68
3	G	Sept. 30	U. S. Engrs.	436.12	430.49	5.63	74,023	72,300	— 1,723	— 2.38
4	F	Oct. 1	U. S. Engrs.	436.87	431.09	5.78	81,143	78,400	— 2,743	— 3.50
5	D	Oct. 2	U. S. Engrs.	438.07	431.59	6.48	89,406	93,200	+ 3,794	+ 4.97
		Oct. 3	U. S. Engrs.	438.90	432.69	6.21	--------	99,000	--------	--------
6	B	Oct. 4	U. S. Engrs.	439.45	433.69	5.76	97,978	100,400	+ 2,422	+ 2.40
7	A	Oct. 5	U. S. Engrs.	439.80	434.39	5.41	105,604	100,600	— 5,004	— 4.97
8	A	Oct. 6	U. S. Engrs.	439.90	434.69	5.21	104,990	99,800	— 5,190	— 5.2
9	A	Oct. 7	U. S. Engrs.	439.97	434.59	5.28	101,548	100,000	— 1,548	— 1.55
10	B	Oct. 8	U. S. Engrs.	439.50	434.49	5.01	97,586	94,000	— 3,586	— 3.81
11	C	Oct. 9	U. S. Engrs.	439.17	434.09	5.08	86,740	91,400	+ 4,660	+ 5.09
		Oct. 10	U. S. Engrs.	439.10	433.39	5.71	--------	96,600	--------	--------
12	C	Oct. 11	U. S. Engrs.	438.90	432.79	6.11	91,041	98,000	+ 6,959	+ 7.1
		Oct. 12	U. S. Engrs.	438.80	432.39	6.41	--------	99,600	--------	--------
		Oct. 13	U. S. Engrs.	438.70	432.09	6.61	--------	100,000	--------	--------
13	G	Oct. 14	U. S. Engrs.	438.45	431.59	6.86	75,313	99,300	+23,987	+24.08
		Oct. 15	U. S. Engrs.	438.25	430.89	7.36	--------	100,200	--------	--------
		Oct. 16	U. S. Engrs.	437.95	430.19	7.76	--------	100,200	--------	--------
		Oct. 17	U. S. Engrs.	437.60	429.39	8.21	--------	99,800	--------	--------
14	E	Oct. 18	U. S. Engrs.	437.15	428.39	8.76	90,453	99,200	+ 8,747	+ 8.8
		Oct. 19	U. S. Engrs.	436.85	427.69	9.16	--------	98,300	--------	--------
15	*	Oct. 20	U. S. Engrs.	436.45	427.19	9.26	110,635	95,200	—15,435	+16.20
		Oct. 21	U. S. Engrs.	436.20	426.69	9.51	--------	94,500	--------	--------
		Oct. 22	U. S. Engrs.	435.85	426.19	9.66	--------	91,900	--------	--------

TABLE NO. B-10—Concluded.

RATING DIAGRAM DISCHARGE AT HARDIN.

Observation No.	Group.	Date.	Authority.	Elevation of water surface. Kampsville.	Grafton.	Total fall.	Discharge. Observed.	Diagram.	Residual = Diagram minus observed. C. F. S.	%
		1926								
		Oct. 23	U. S. Engrs.	435.55	425.69	9.86	--------	90,500	----------	--------
		Oct. 24	U. S. Engrs.	435.20	425.09	10.11	--------	88,400	----------	--------
16	I	Oct. 25	U. S. Engrs.	434.87	424.69	10.18	84,102	85,100	+ 998	+ 1.17
		Oct. 26	U. S. Engrs.	434.60	424.89	9.71	--------	81,000	----------	--------
17	I	Oct. 27	U. S. Engrs.	434.17	424.29	9.88	84,855	77,200	— 7,655	— 9.92
		Oct. 28	U. S. Engrs.	433.90	424.09	9.81	--------	74,700	----------	--------
18	J	Oct. 29	U. S. Engrs.	433.47	423.89	9.58	67,292	69,900	+ 2,608	+ 3.73
		Oct. 30	U. S. Engrs.	433.25	423.59	9.66	--------	68,100	----------	--------
		Oct. 31	U. S. Engrs.	432.90	423.39	9.51	--------	64,400	----------	--------
19	J	Nov. 1	U. S. Engrs.	432.50	422.99	9.51	60,209	61,100	+ 891	+ 1.46
20	K	Nov. 3	U. S. Engrs.	431.60	422.39	9.21	55,562	54,800	— 762	— 1.39
21	K	Nov. 5	U. S. Engrs.	430.85	421.79	9.06	51,750	51,100	— 650	— 1.27
22	L	Nov. 10	U. S. Engrs.	429.40	421.19	8.21	43,783	43,800	+ 17	0.00
		1927								
		Apr. 18	U. S. Engrs.	439.63	435.3	4.33	--------	88,600	----------	--------
		Apr. 19	U. S. Engrs.	439.38	435.3	4.08	--------	84,300	----------	--------
		Apr. 20	U. S. Engrs.	439.48	435.4	4.08	--------	85,100	----------	--------
		Apr. 21	U. S. Engrs.	439.58	435.5	4.08	--------	85,800	----------	--------
		Apr. 22	U. S. Engrs.	439.63	435.7	3.93	--------	84,900	----------	--------
		Apr. 23	U. S. Engrs.	439.73	435.9	3.83	--------	85,000	----------	--------
		Apr. 24	U. S. Engrs.	440.08	436.35	3.73	--------	86,200	----------	--------
		Apr. 25	U. S. Engrs.	440.48	436.6	3.88	--------	91,700	----------	--------
		Apr. 26	U. S. Engrs.	440.73	436.6	4.13	--------	96,900	----------	--------
		Apr. 27	U. S. Engrs.	440.68	436.2	4.48	--------	100,000	----------	--------
		Apr. 28	U. S. Engrs.	440.33	435.3	5.03	--------	102,100	----------	--------
		Apr. 29	U. S. Engrs.	439.88	433.8	6.08	--------	107,300	----------	--------
		Apr. 30	U. S. Engrs.	439.28	432.8	6.48	--------	104,500	----------	--------
		May 1	U. S. Engrs.	438.63	431.6	7.03	--------	102,300	----------	--------
		May 2	U. S. Engrs.	437.98	430.4	7.58	--------	99,600	----------	--------
		May 3	U. S. Engrs.	437.43	429.8	7.63	--------	95,100	----------	--------
		May 4	U. S. Engrs.	436.98	429.2	7.78	--------	92,000	----------	--------
		May 5	U. S. Engrs.	436.63	428.8	7.83	--------	89,500	----------	--------
		May 6	U. S. Engrs.	436.23	428.3	7.93	--------	86,600	----------	--------
		May 7	U. S. Engrs.	435.93	427.99	7.94	--------	84,400	----------	--------
		May 8	U. S. Engrs.	436.13	428.3	7.83	--------	85,500	----------	--------
		May 9	U. S. Engrs.	436.18	428.8	7.38	--------	83,000	----------	--------
		May 10	U. S. Engrs.	436.23	429.6	6.63	--------	79,500	----------	--------
		May 11	U. S. Engrs.	436.23	430.18	6.05	--------	76,000	----------	--------
		May 12	U. S. Engrs.	436.08	429.9	6.18	--------	76,400	----------	--------
		May 13	U. S. Engrs.	435.78	429.4	6.38	--------	74,300	----------	--------
		June 1	U. S. Engrs.	438.28	431.7	6.58	--------	95,500	----------	--------
		June 2	U. S. Engrs.	438.18	431.5	6.68	--------	95,500	----------	--------
		June 3	U. S. Engrs.	438.03	431.15	6.88	--------	95,700	----------	--------
		June 4	U. S. Engrs.	438.03	431.25	6.78	--------	94,900	----------	--------
		June 5	U. S. Engrs.	438.18	431.8	6.38	--------	93,200	----------	--------
		June 6	U. S. Engrs.	438.38	432.4	5.98	--------	91,800	----------	--------
		June 7	U. S. Engrs.	438.73	433.4	5.33	--------	90,000	----------	--------
		June 8	U. S. Engrs.	439.03	433.75	5.28	--------	92,500	----------	--------
		June 9	U. S. Engrs.	439.18	433.5	5.68	--------	97,100	----------	--------
		June 10	U. S. Engrs.	439.03	432.8	6.23	--------	100,500	----------	--------
		June 11	U. S. Engrs.	438.63	431.8	6.83	--------	101,200	----------	--------
		June 12	U. S. Engrs.	438.23	430.8	7.43	--------	101,400	----------	--------

* Not used in construction of diagram.

TABLE NO. B-11—ILLINOIS RIVER DISCHARGES.

(1) From Stage-Slope Discharge Diagram, (2) U. S. Engineers' Rating Curve, and (3) U. S. Geological Survey Rating Curve, April, 1927.

Date—April, 1927.	Elevation at water surface.		Fall—Peoria to Pekin.	Discharge Peoria.		
	Peoria.	Pekin.		Diagram.	U. S. Eng. curve.	U.S.G.S. curve.
1	455.02	453.57	1.45	31,400	38,200	32,400
2	454.92	453.52	1.40	30,500	37,500	32,000
3	454.82	453.42	1.40	30,200	37,300	31,300
4	454.82	453.57	1.25	27,900	37,300	32,000
5	455.12	453.67	1.45	31,650	38,800	32,400
6	455.22	453.72	1.50	32,600	39,300	32,700
7	455.32	453.87	1.45	32,400	39,700	33,400
8	455.32	453.82	1.50	32,900	39,700	33,400
9	455.42	453.87	1.55	33,800	40,200	33,400
10	455.32	453.77	1.55	33,400	39,700	33,000
11	455.12	453.67	1.45	31,650	38,800	32,700
12	455.02	453.57	1.45	31,400	38,200	32,400
13	454.92	453.67	1.25	28,800	37,500	32,700
14	454.92	453.52	1.40	30,500	37,500	32,000
15	454.92	453.42	1.50	31,500	37,500	31,600
16	454.92	453.62	1.30	29,500	37,500	32,000
17	455.02	453.72	1.30	29,900	38,200	32,000
18	455.42	454.02	1.40	32,300	40,200	34,200
19	456.22	454.87	1.35	34,400	45,200	36,200
20	457.42	455.97	1.45	40,200	52,300	42,000
21	458.82	457.47	1.35	44,800	60,500	47,800
22	459.82	458.17	1.65	52,700	66,200	52,800
23	460.22	458.57	1.65	56,300	68,700	56,100
24	460.22	458.57	1.65	56,300	68,700	56,100
25	460.22	458.40	1.82	59.200	68,700	55,000
26	460.02	458.12	1.90	59,500	67,700	53,300
27	459.62	457.92	1.70	58,300	65,100	51,800
28	459.02	457.57	1.45	47,200	61,800	49,300
29	458.82	457.27	1.55	47,800	60,500	47,800
30	458.72	457.17	1.55	47,400	60,000	46,900

TABLE NO. B-12—ILLINOIS RIVER DISCHARGES.

(1) From Stage-Slope Discharge Diagram, (2) U. S. Engineers' Rating Curve, and (3) U. S. Geological Survey Rating Curve April, 1927.

Date—April, 1927.	Elevation at water surface.		Fall—Havana to Bath.	Discharge Havana.		
	Havana.	Bath.		Diagram.	U. S. Eng. curve.	U.S.G.S. curve.
1	449.56	448.56	1.00	36,500	47,000	40,800
2	449.76	448.76	1.00	37,300	48,200	41,600
3	449.76	448.76	1.00	37,300	48,200	41,600
4	449.76	448.86	.90	35,300	48,200	41,600
5	449.86	448.96	.90	35,700	48,700	41,900
6	449.86	449.06	.80	33,600	48,700	41,900
7	449.86	449.06	.80	33,600	48,700	41,900
8	449.86	449.06	.80	33,600	48,700	41,900
9	449.96	449.06	.90	36,000	49,300	42,200
10	449.96	449.16	.80	33,900	49,300	42,200
11	449.96	449.16	.80	33,900	49,300	42,200
12	449.96	449.06	.90	36,000	49,300	42,200
13	449.96	449.06	.90	36,000	49,300	42,200
14	449.96	449.16	.80	33,900	49,300	42,200
15	450.06	449.36	.70	31,700	49,900	42,600
16	450.16	449.46	.70	32,000	50,300	43,000
17	450.46	449.56	.90	37,800	52,100	44,000
18	450.46	449.76	.70	32,900	52,100	44,000
19	450.96	450.06	.90	39,700	54,700	46,000
20	451.46	450.56	.90	41,900	57,500	48,000
21	452.06	451.06	1.00	47,100	60,800	51,000
22	452.76	451.66	1.10	54,000	64,700	54,900
23	453.26	452.26	1.00	55,000	------------	58,300
24	453.66	452.76	.90	55,000	------------	61,400
25	453.86	453.06	.80	53,400	------------	63,000
26	453.96	453.26	.70	51,000	------------	63,900
27	453.96	453.26	.70	51,000	------------	63,900
28	453.76	453.06	.70	49,200	------------	62,200
29	453.56	452.86	.70	47,800	------------	60,600
30	453.36	452.56	.80	49,500	------------	59,000

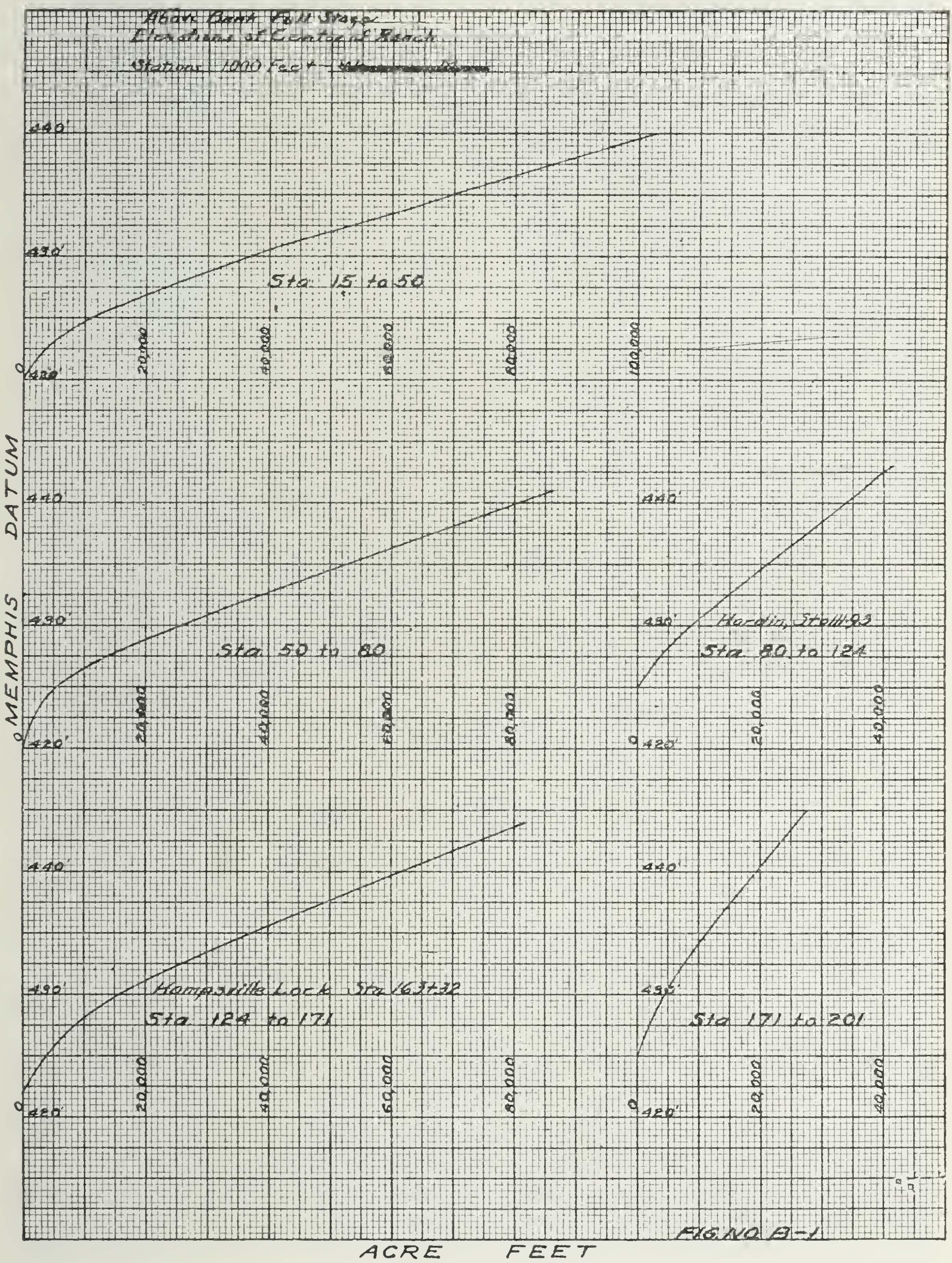
TABLE NO. B-13—ILLINOIS RIVER DISCHARGES.

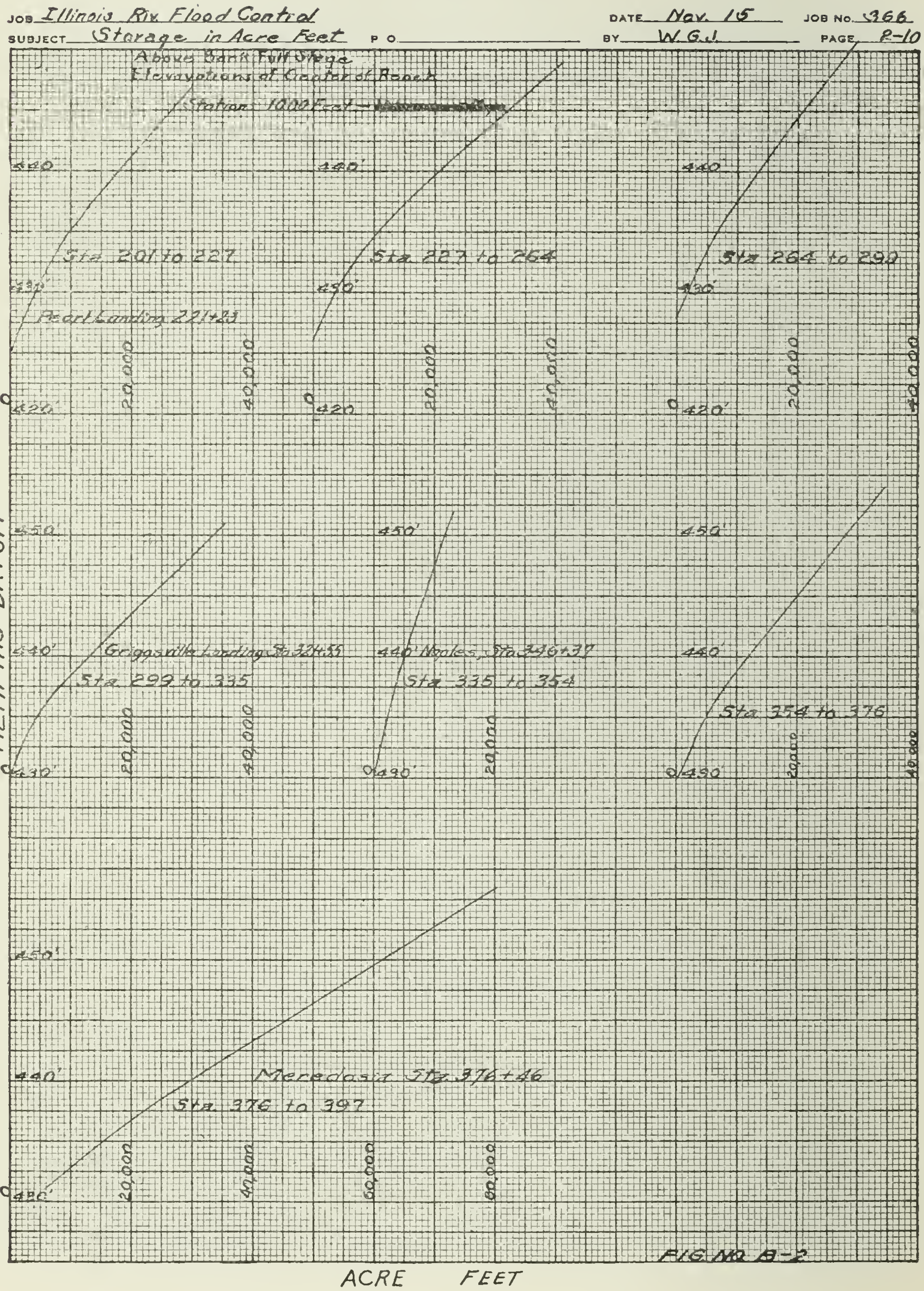
(1) From Stage-Slope Discharge Diagram, (2) U. S. Engineers' Rating Curve, and (3) U. S. Geological Survey Rating Curve, April, 1927.

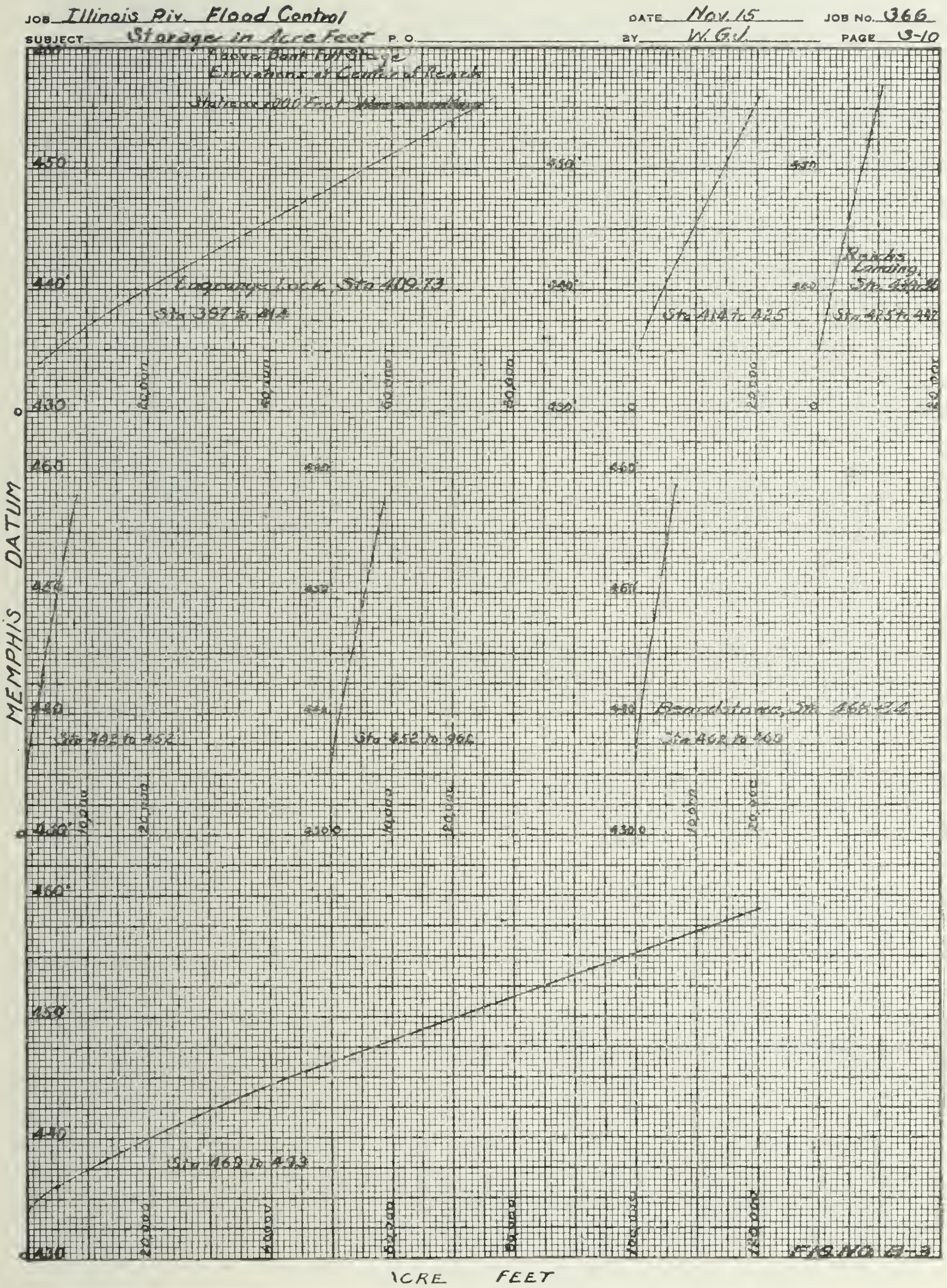
Date—April, 1927.	Elevation at water surface.		Fall—Beardstown to LaGrange.	Discharge Beardstown.		
	Beardstown.	LaGrange.		Diagram.	U. S. Eng. curve.	U.S.G.S. curve.
1	447.85	445.33	2.52	60,300	62,600	61,900
2	448.00	445.68	2.32	58,600	63,800	62,900
3	448.07	445.83	2.24	57,700	64,200	63,400
4	448.07	445.78	2.29	58,400	64,200	63,400
5	448.25	446.08	2.17	57,600	65,600	64,000
6	448.28	446.13	2.15	57,400	65,700	64,000
7	448.31	446.13	2.18	57,900	66,100	64,500
8	448.35	446.08	2.27	59,400	66,300	64,500
9	448.45	446.08	2.37	60,900	67,100	65,000
10	448.48	446.03	2.45	61,800	67,300	65,000
11	448.43	445.98	2.45	61,700	67,050	65,000
12	448.35	445.93	2.42	61,200	66,300	64,000
13	448.49	446.13	2.36	60,800	67,300	64,500
14	448.65	446.48	2.17	58,000	68,400	64,500
15	448.75	446.68	2.07	58,400	69,300	65,000
16	448.89	446.83	2.06	58,600	70,200	65,600
17	448.97	446.88	2.09	59,500	71,200	66,200
18	449.17	446.93	2.14	60,800	72,700	67,200
19	449.43	447.03	2.40	65,400	75,300	69,400
20	449.95	447.43	2.52	69,400	79,700	73,000
21	450.40	447.83	2.57	71,800	83,600	75,400
22	450.89	448.03	2.86	78,100	87,300	79,300
23	451.52	448.38	3.14	84,600	92,700	84,400
24	452.02	448.83	3.19	87,600	----------	87,600
25	452.28	449.13	3.15	88,600	----------	90,300
26	452.35	449.28	3.07	87,800	----------	92,100
27	452.45	449.38	3.07	87,200	----------	92,100
28	452.26	449.38	2.88	84,500	----------	91,200
29	452.17	449.33	2.84	83,300	----------	89,400
30	451.88	449.08	2.80	81,800	----------	86,800

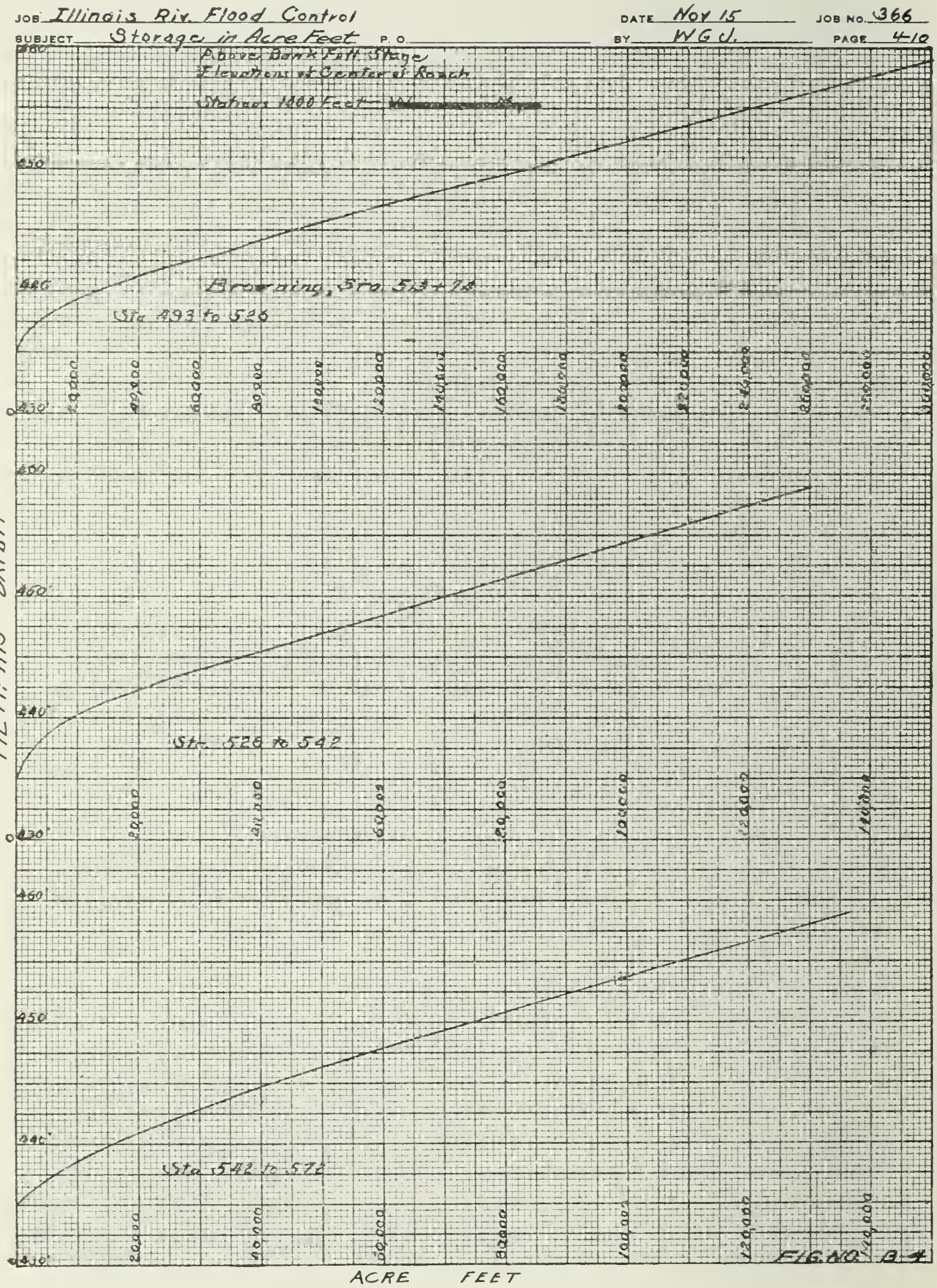
STORAGE IN ACRE FEET
(Ten Diagrams)

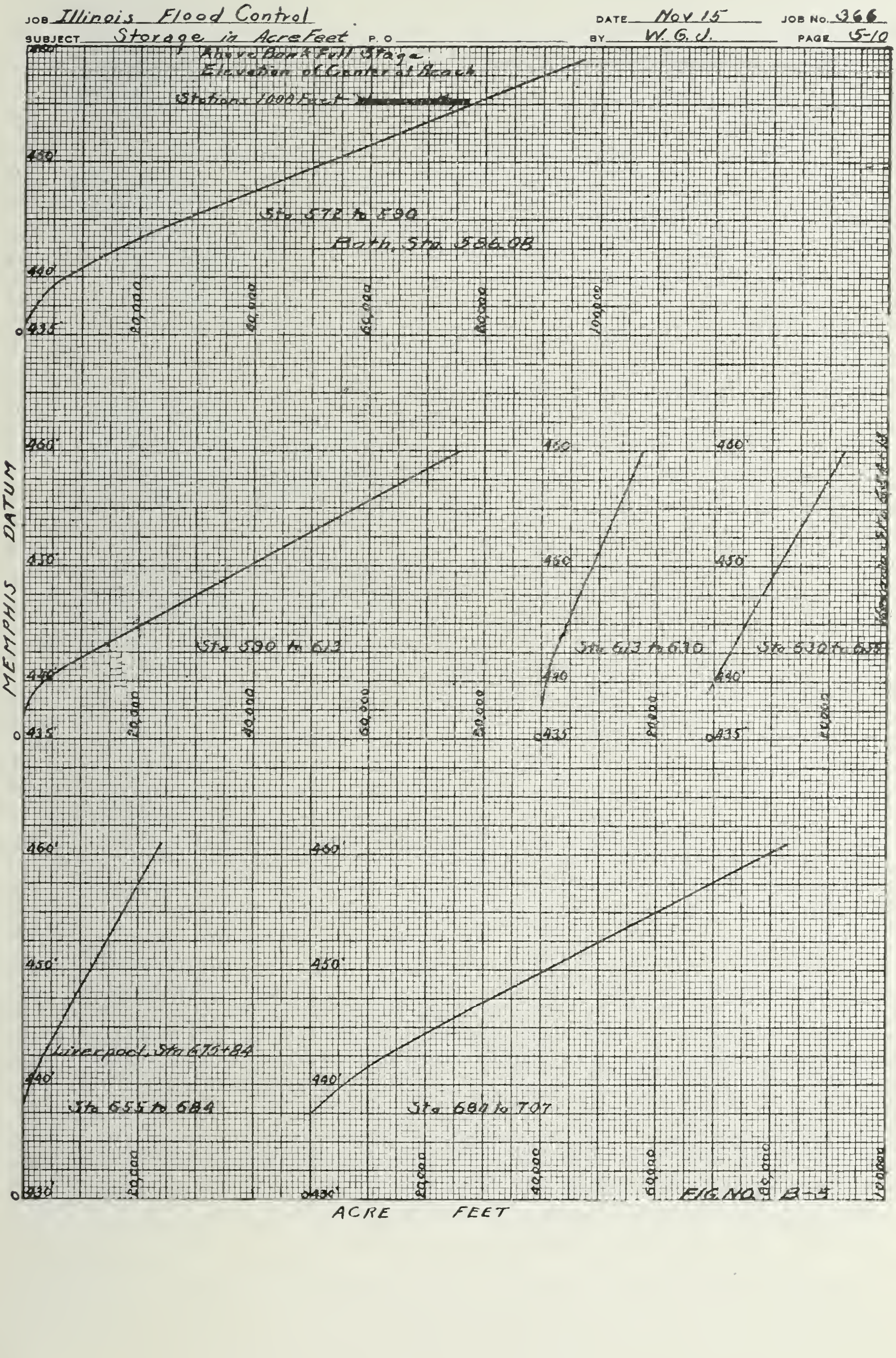
Page 1-10

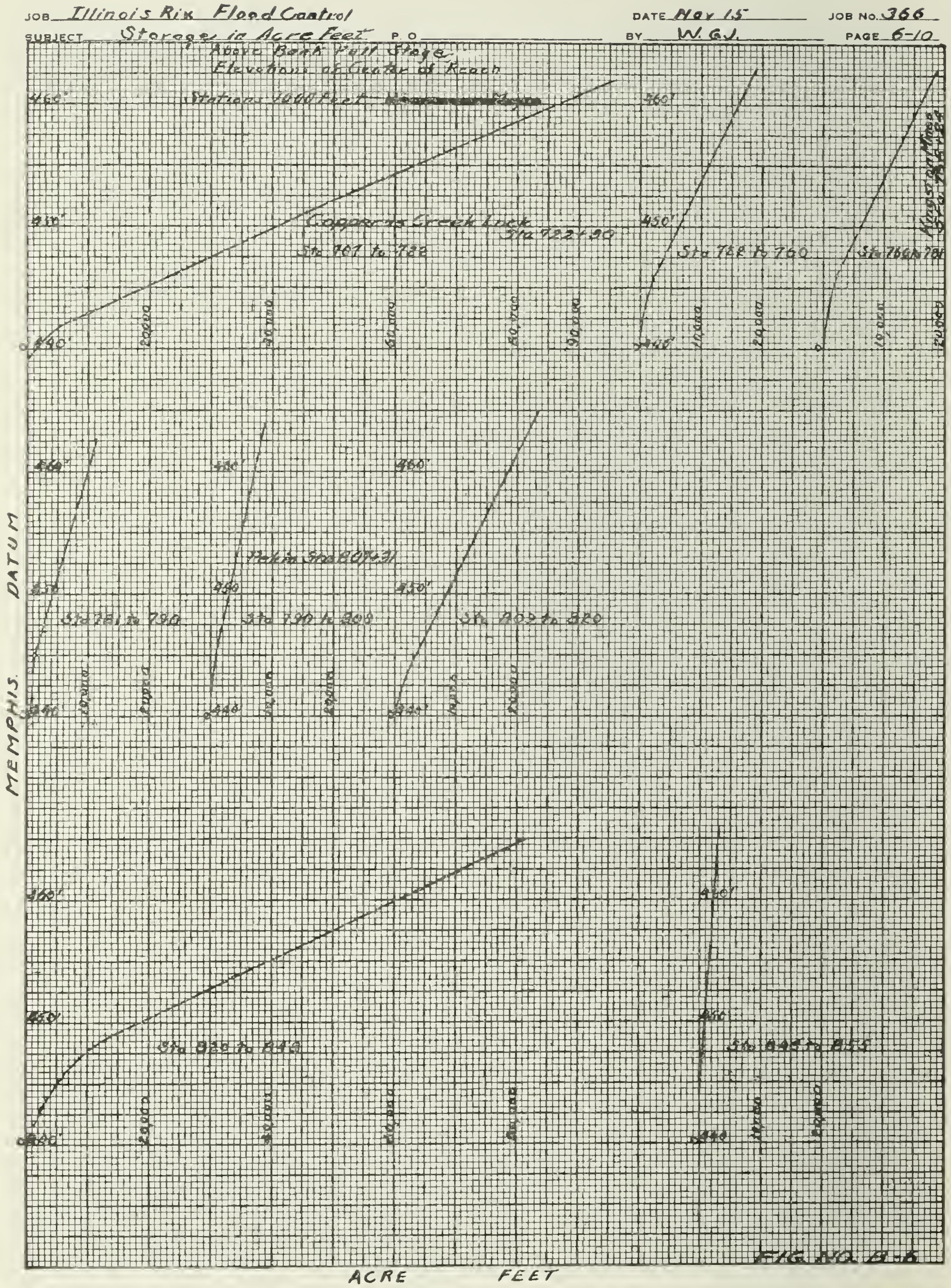


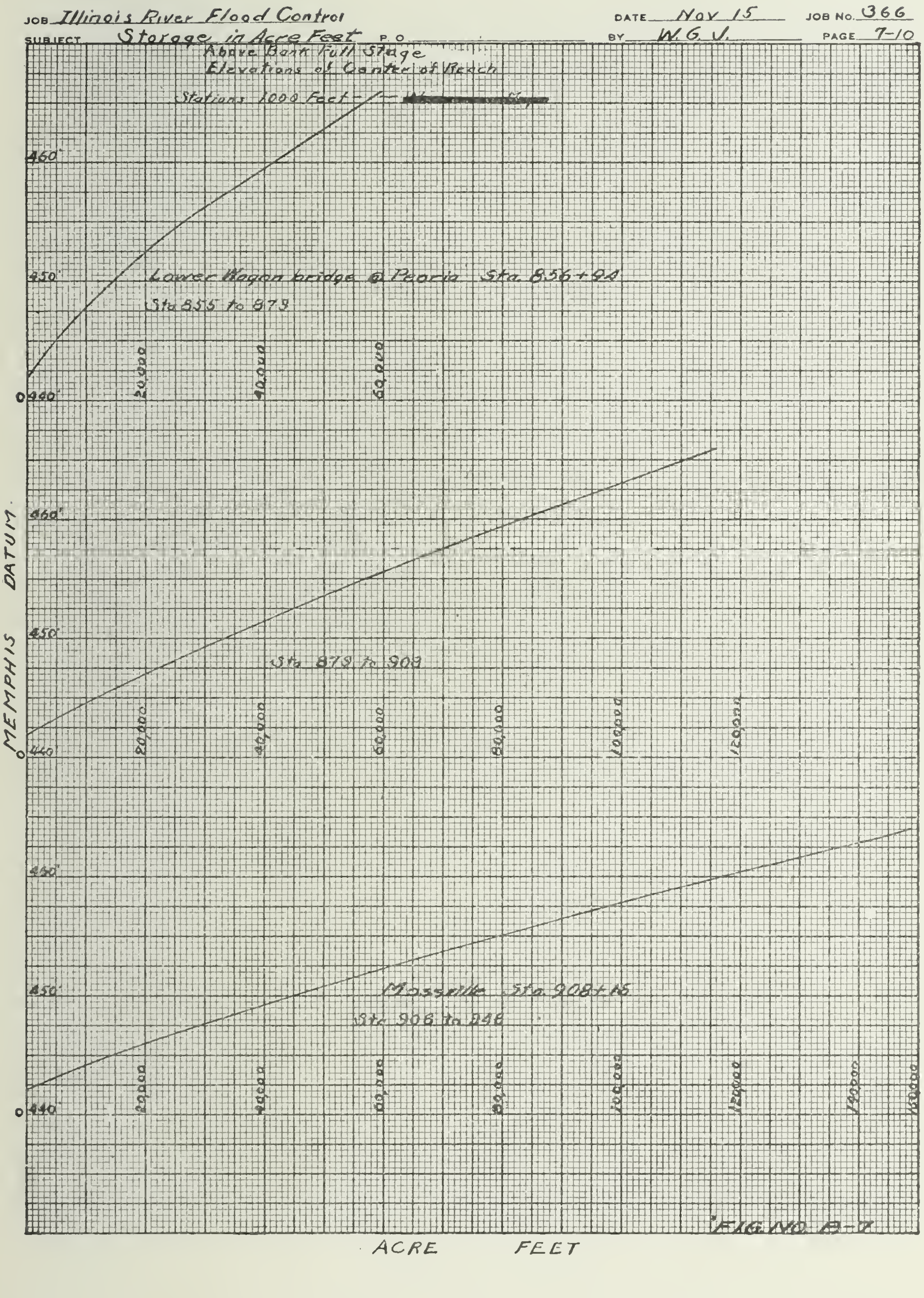

JOB Illinois Riv. Flood Control
DATE Nov. 15
JOB No. 366
SUBJECT Storage in Acre Feet
P O.
BY W.G.J.
PAGE 8-10
Above Bank Full Stage
Elevations of Center of Reach
Station 1000 Feet
Sta. 201 to 227
Pearl Landing 221+23
Sta. 227 to 264
Sta. 264 to 290
Griggsville Landing Sta 324+55
Sta. 299 to 335
440' Naples, Sta 346+37
Sta. 335 to 354
Sta. 354 to 376
Meredosia Sta. 376+46
Sta. 376 to 397
440'
430'
420'
450'
20,000
40,000
60,000
80,000
MEMPHIS DATUM
ACRE FEET
FIG. NO. B-2

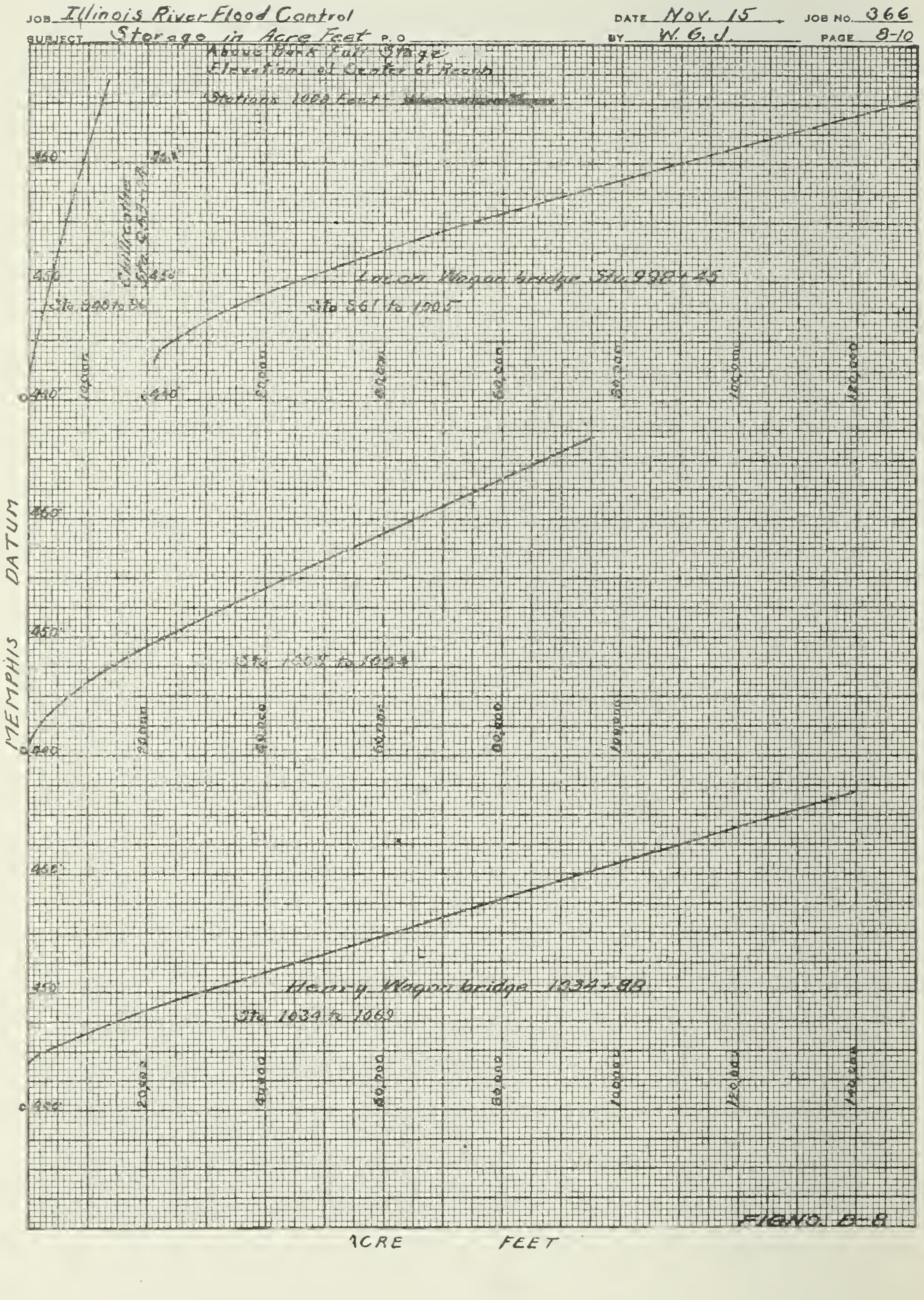

JOB Illinois Riv. Flood Control
DATE Nov. 15
JOB NO. 366
SUBJECT Storage in Acre Feet
P. O.
BY W. G. J.
PAGE 3-10
Elevations at Center of Reach
Engrams Lock Sta 409.73
Sta 387 to 414
Sta 414 to 425
Sta 425 to 437
Sta 452 to 466
Sta 466 to 469
Beardstown, Sta 468+24
Sta 469 to 473
MEMPHIS DATUM
ACRE FEET

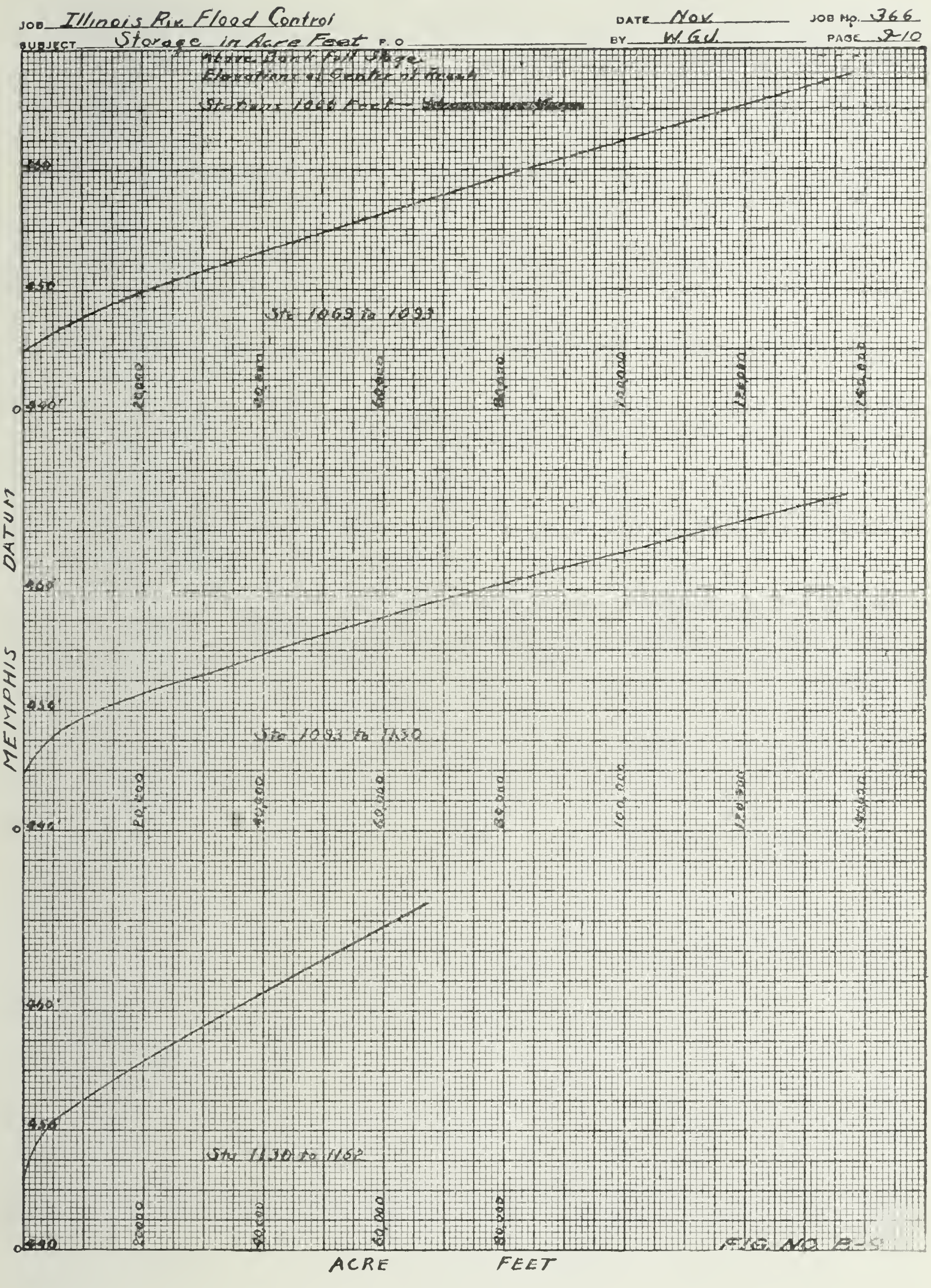

JOB Illinois Riv. Flood Control
DATE Nov 15
JOB NO. 366
SUBJECT Storage in Acre Feet
P. O.
BY W G J.
PAGE 4-10
Above Bank Full Stage
Elevations at Center of Reach
Stations 1000 Feet
Browning, Sta 513+78
Sta 493 to 526
Sta 526 to 542
Sta 542 to 572
MEMPHIS DATUM
ACRE FEET
FIG. NO. B-4

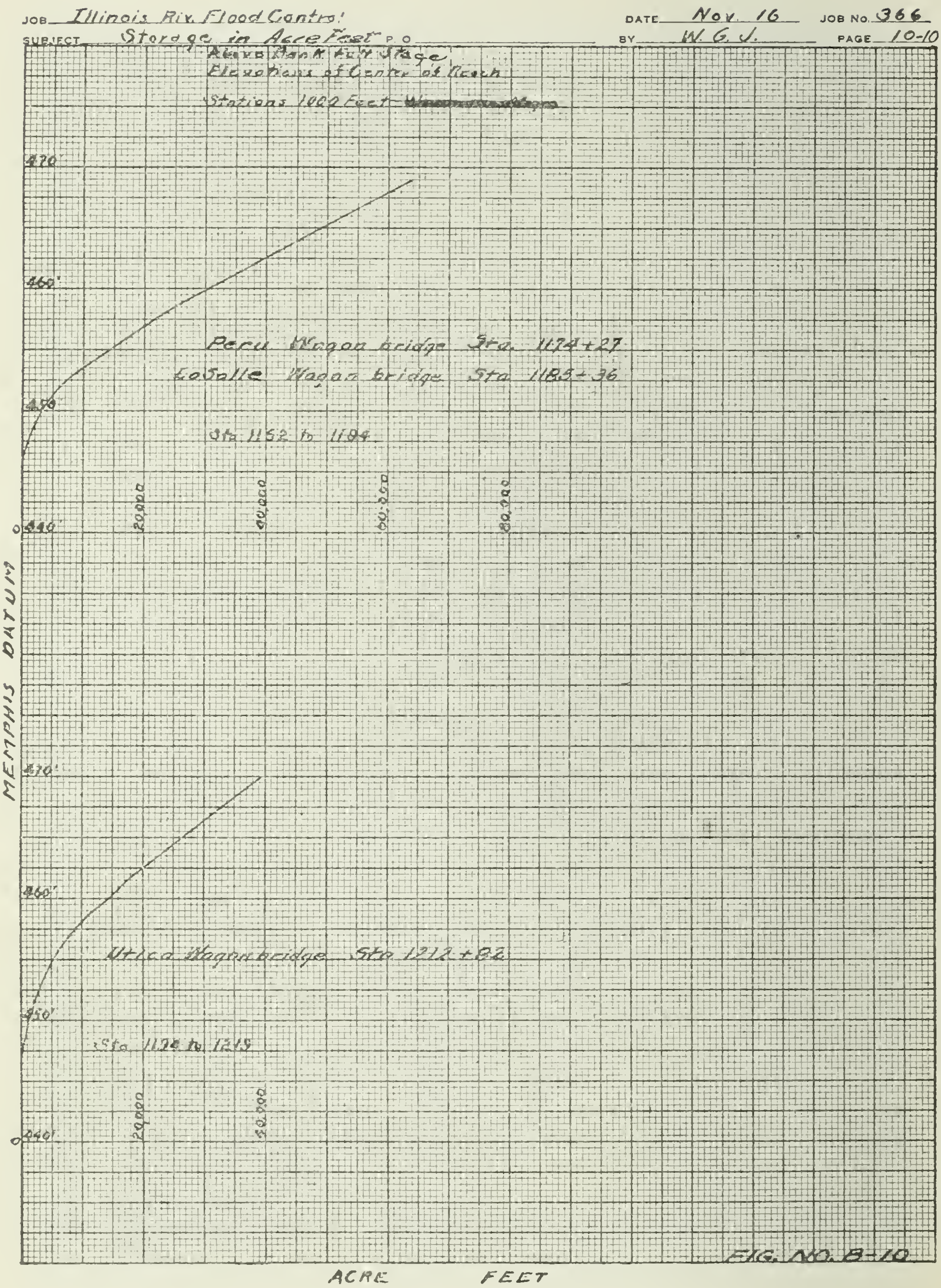

JOB Illinois Flood Control
DATE Nov 15
JOB NO. 366
SUBJECT Storage in Acre Feet
BY W. G. J.
PAGE 5-10
Above Bank Full Stage
Elevation of Center of Reach
Stations 1000 Feet
Sta 572 to 590
Bath. Sta 586.08
Sta 590 to 613
Sta 613 to 630
Sta 630 to 655
Liverpool Sta 675+84
Sta 655 to 684
Sta 684 to 707
MEMPHIS DATUM
ACRE FEET
FIG. NO. B-5


JOB Illinois Riv Flood Control
DATE Nov 15
JOB NO. 366
SUBJECT Storage in Acre Feet
BY W.G.J.
PAGE 6-10
Above Bank Full Stage
Elevations of Center of Reach
Stations 1000 Feet
Coppers Creek Lock
Sta 722+90
Sta 701 to 722
Sta 722 to 760
Sta 760 to 781
Kingston Mines
Pekin Sta 807+31
Sta 781 to 790
Sta 790 to 802
Sta 802 to 820
Sta 820 to 845
Sta 845 to 855
MEMPHIS DATUM
ACRE FEET
FIG. NO. B-6


JOB Illinois River Flood Control
DATE Nov 15
JOB NO. 366
SUBJECT Storage in Acre Feet
BY W.G.J.
PAGE 7-10
Above Bank Full Stage
Elevations of Center of Reach
Stations 1000 Feet
Lower Wagon bridge @ Peoria Sta. 856+94
Sta 855 to 879
Sta 879 to 908
Mossville Sta 908+16
Sta 908 to 948
MEMPHIS DATUM
ACRE FEET
FIG NO. B-7


JOB Illinois River Flood Control
DATE Nov. 15
JOB NO. 366
SUBJECT Storage in Acre Feet
BY W. G. J.
PAGE 8-10
Above Bank Full Stage
Elevations at Center of Reach
Stations 1000 Feet
Chillicothe Sta. 962+00
Sta. 949 to 961
Lacon Wagon bridge Sta. 998+25
Sta. 961 to 1005
Sta. 1005 to 1034
Henry Wagon bridge 1034+88
Sta. 1034 to 1069
MEMPHIS DATUM
ACRE FEET
FIG NO. B-8


JOB Illinois Riv. Flood Control
SUBJECT Storage in Acre Feet
DATE Nov.
BY W.G.J.
JOB No. 366
PAGE 2-10
Above Bank Full Stage
Elevations at Center of Reach
Stations 1000 Feet
Sta 1063 to 1093
Sta 1093 to 1130
Sta 1130 to 1162
MEMPHIS DATUM
ACRE FEET
FIG. NO. B-5


JOB Illinois Riv. Flood Control
DATE Nov. 16
JOB No. 366
SUBJECT Storage in Acre Feet
BY W. G. J.
PAGE 10-10
Elevations of Center of Reach
Stations 1000 Feet
Peru Wagon bridge Sta. 1174+27
LaSalle Wagon bridge Sta 1185+36
Sta. 1152 to 1184
20,000
40,000
60,000
80,000
MEMPHIS DATUM
Utica Wagon bridge Sta 1212+82
Sta 1124 to 1215
FIG. NO. B-10
ACRE FEET

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1890
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

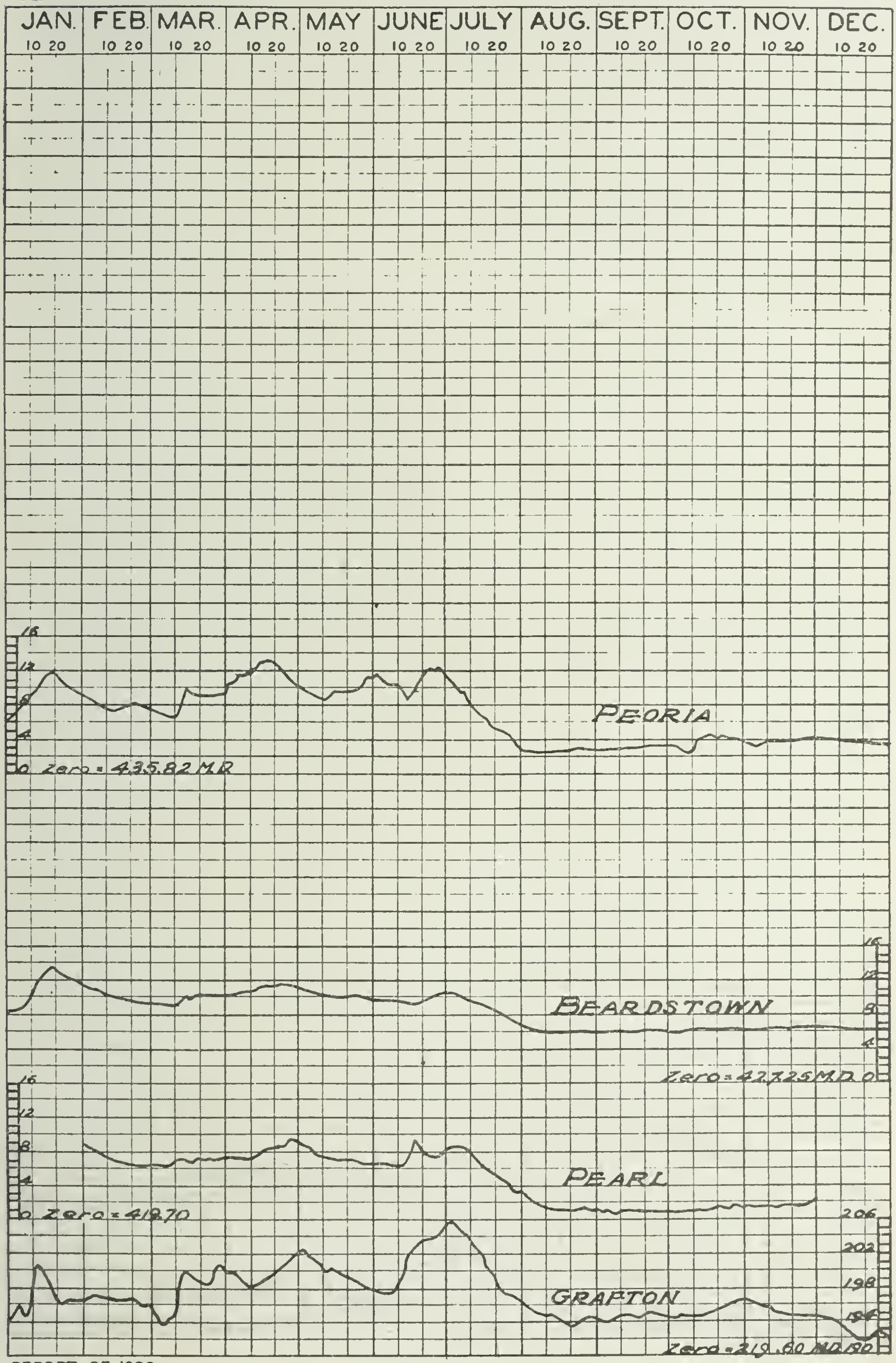


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FIGURE B11

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1891
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

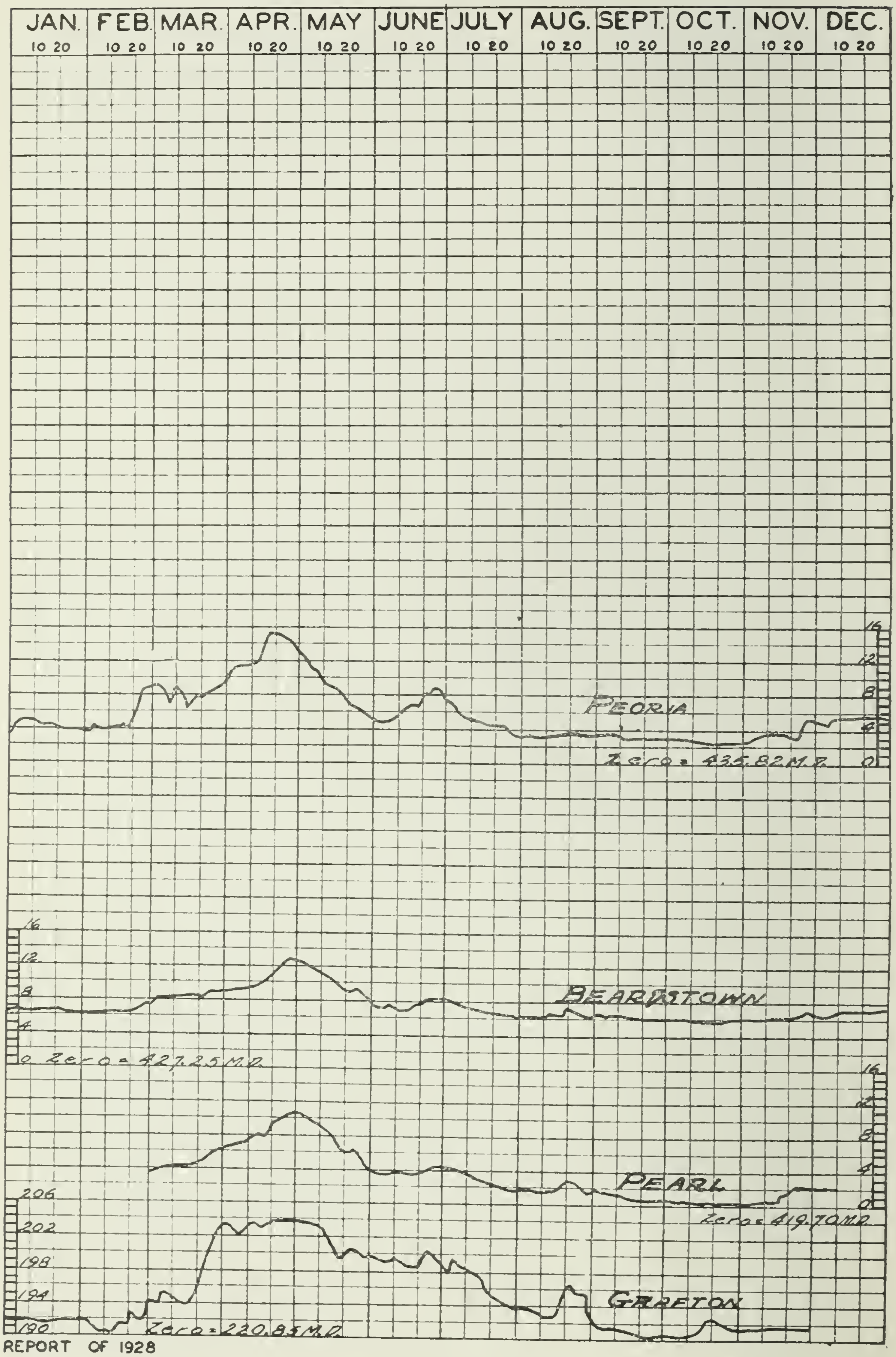

FIGURE. B12

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1892
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

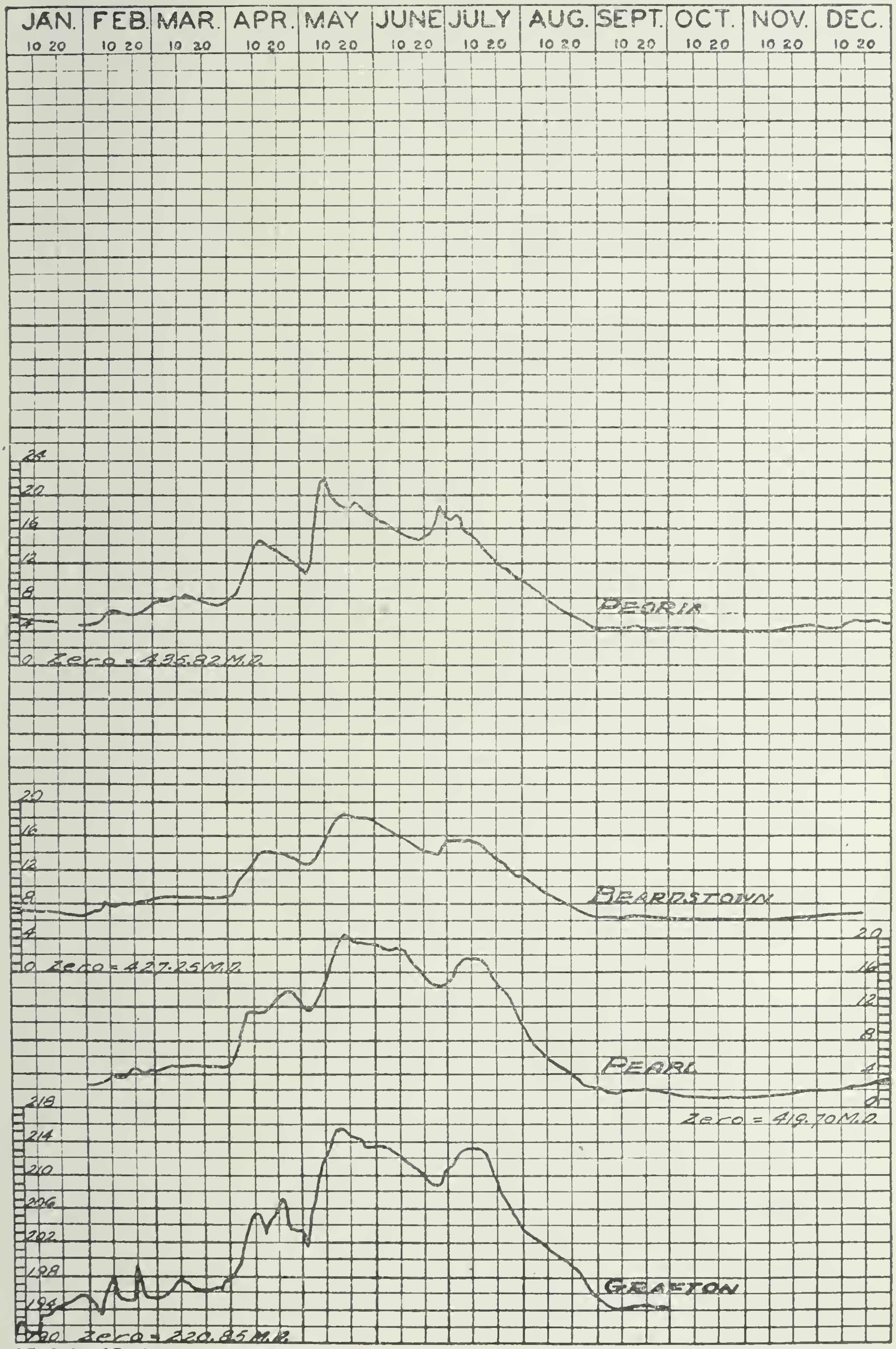

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FIGURE B13

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1893
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

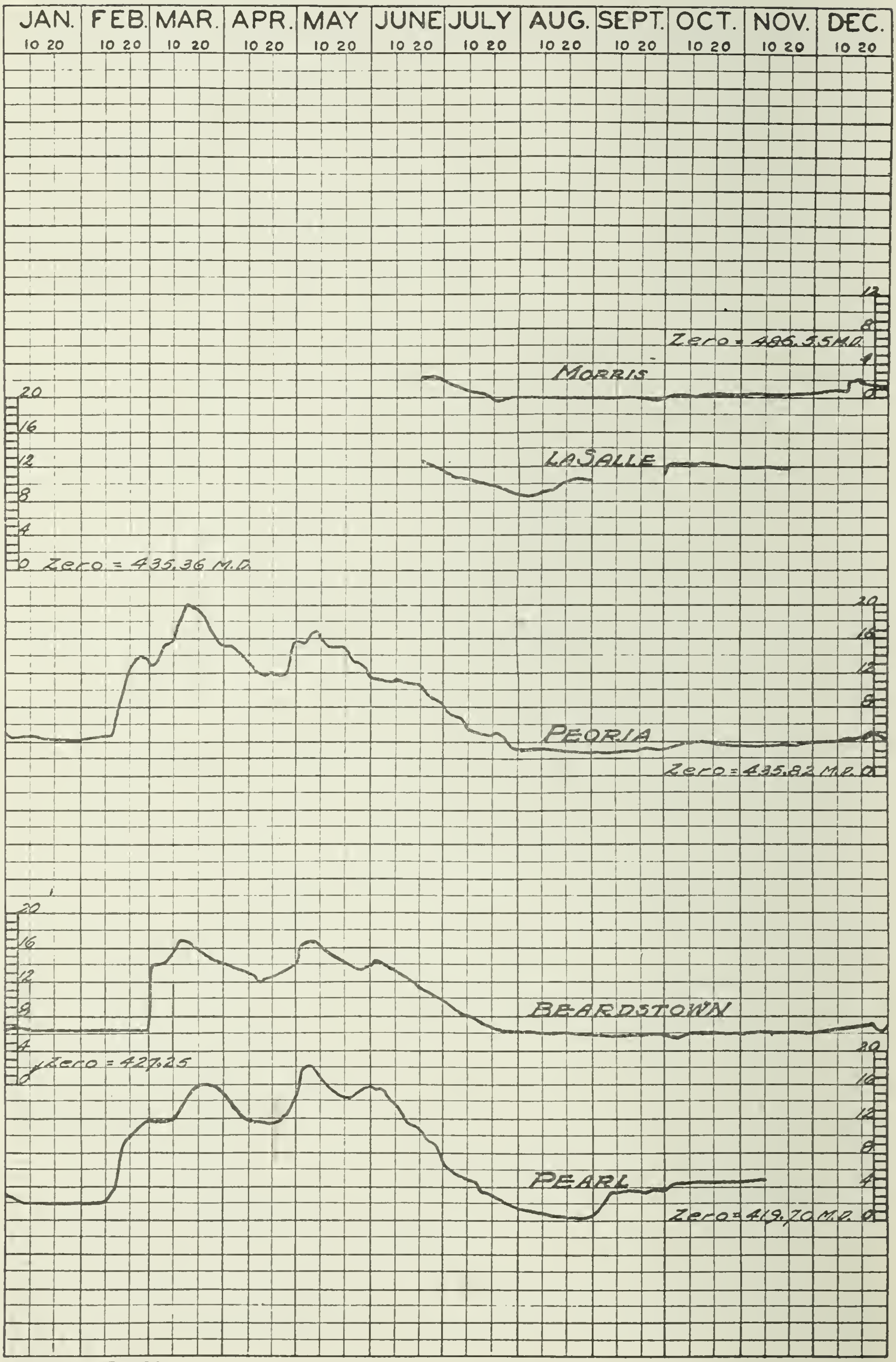

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FIGURE B 14

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1894
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

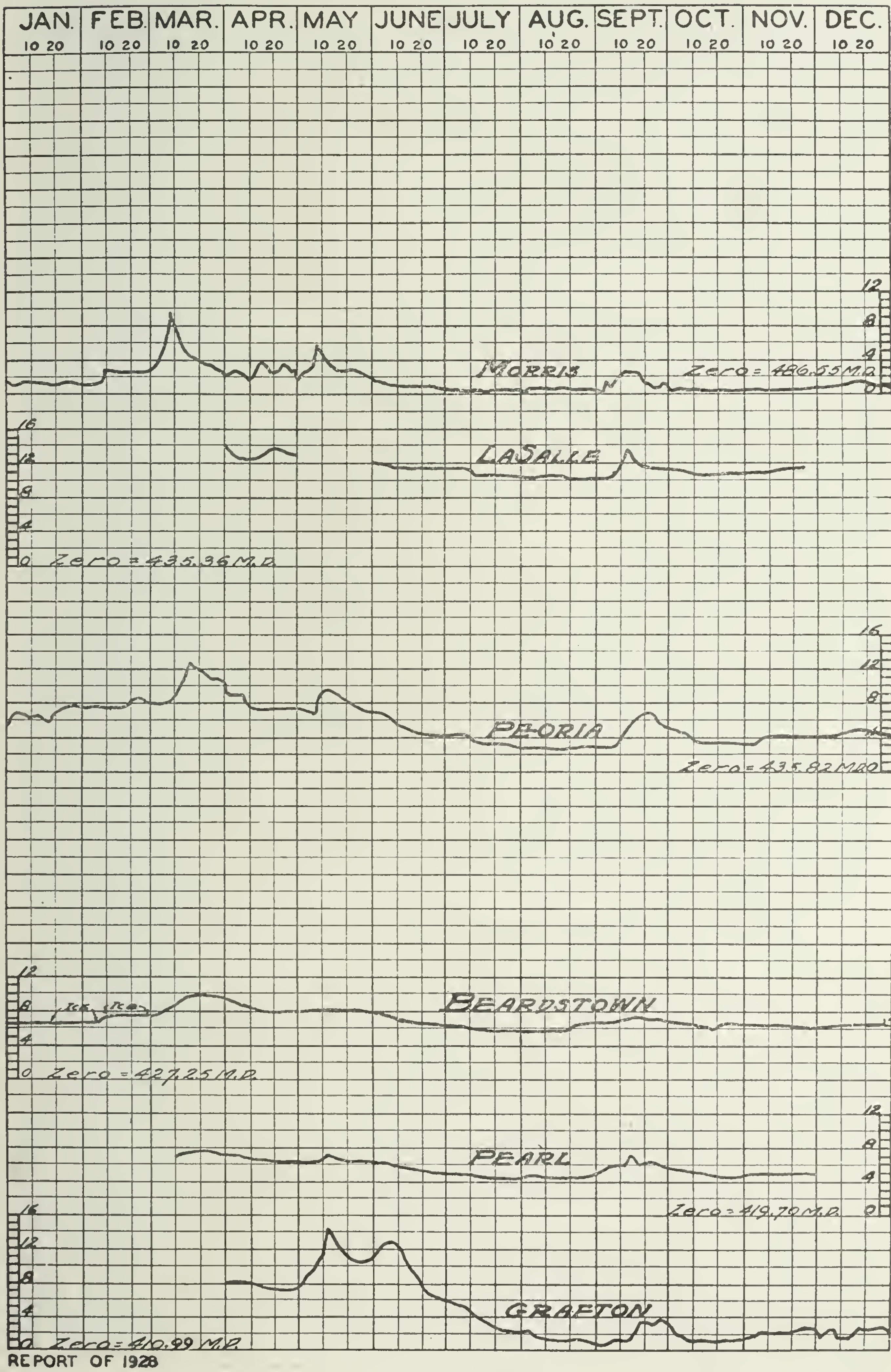

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FIGURE B 15

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1895
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

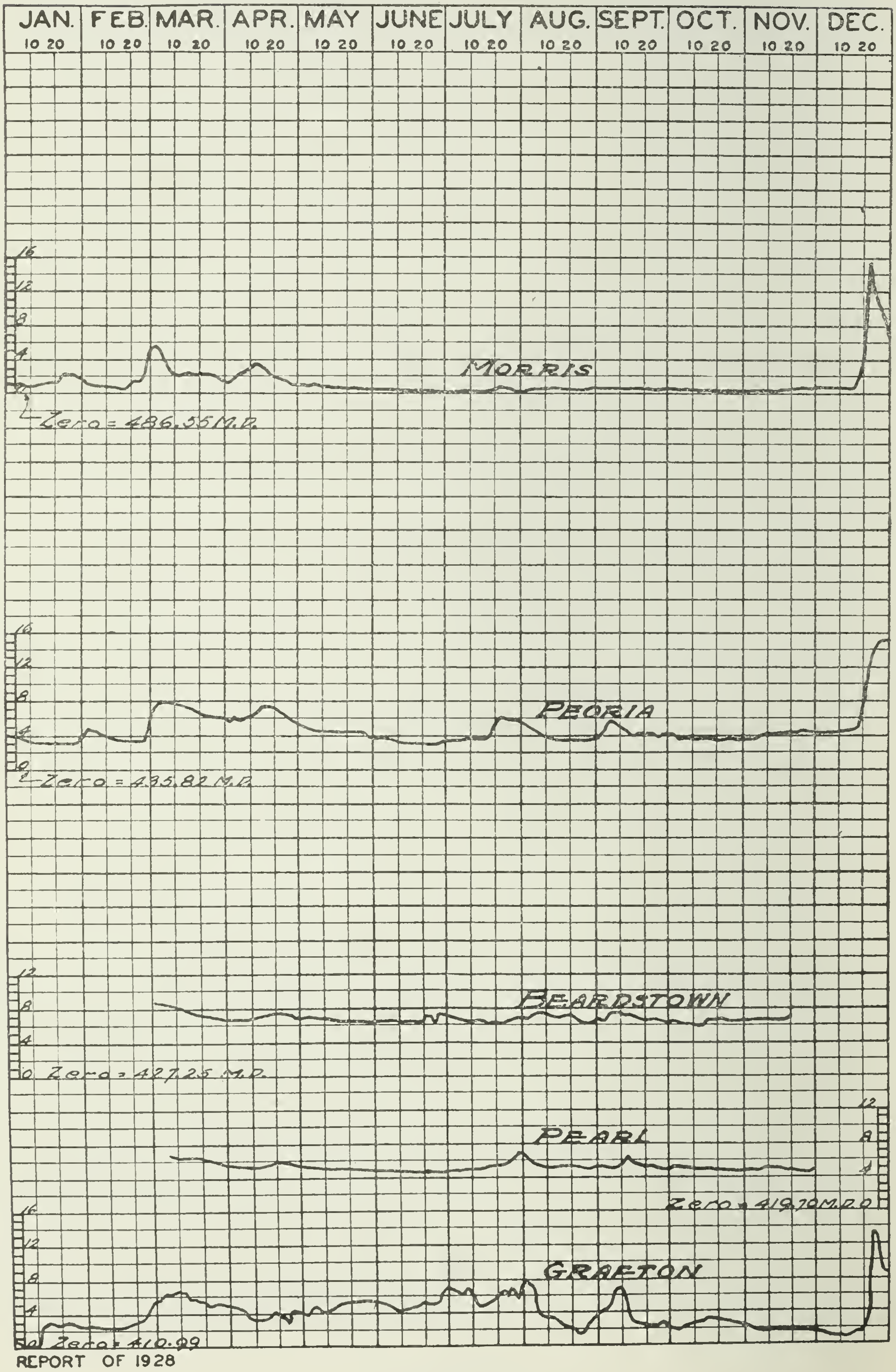

FIGURE B16

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1896
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

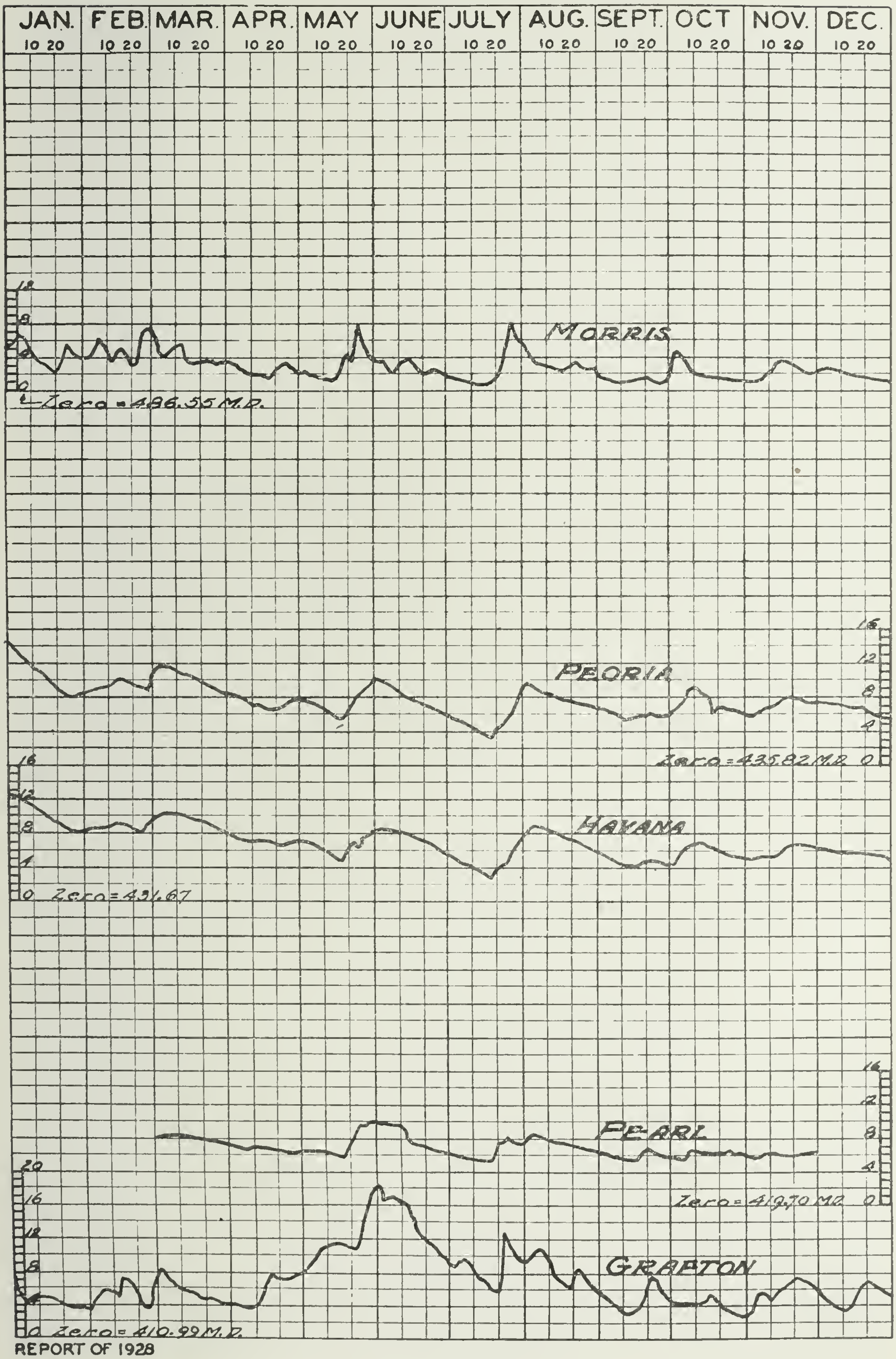

FIGURE B 17

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1897
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

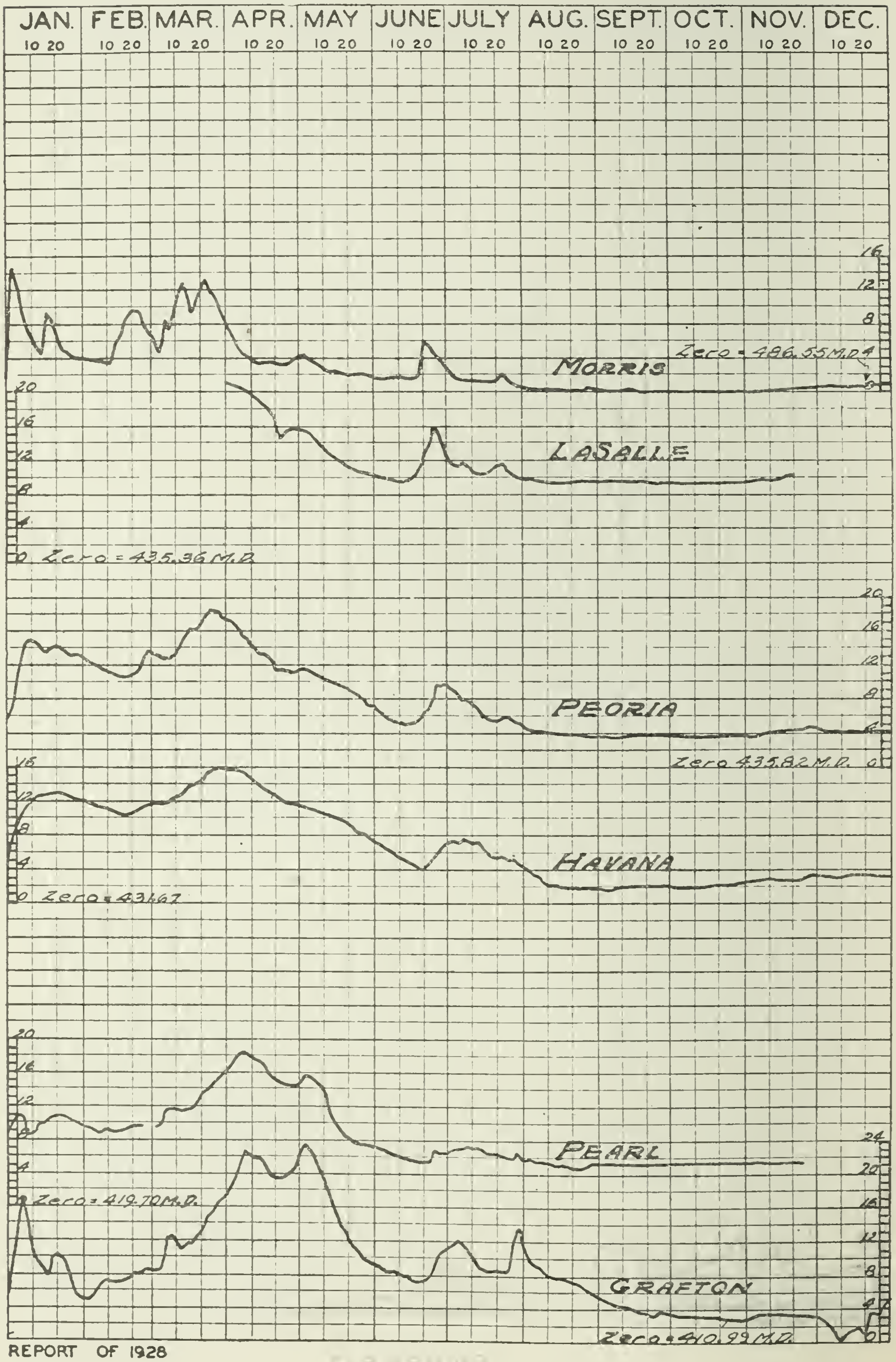

FIGURE B.18

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1898
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

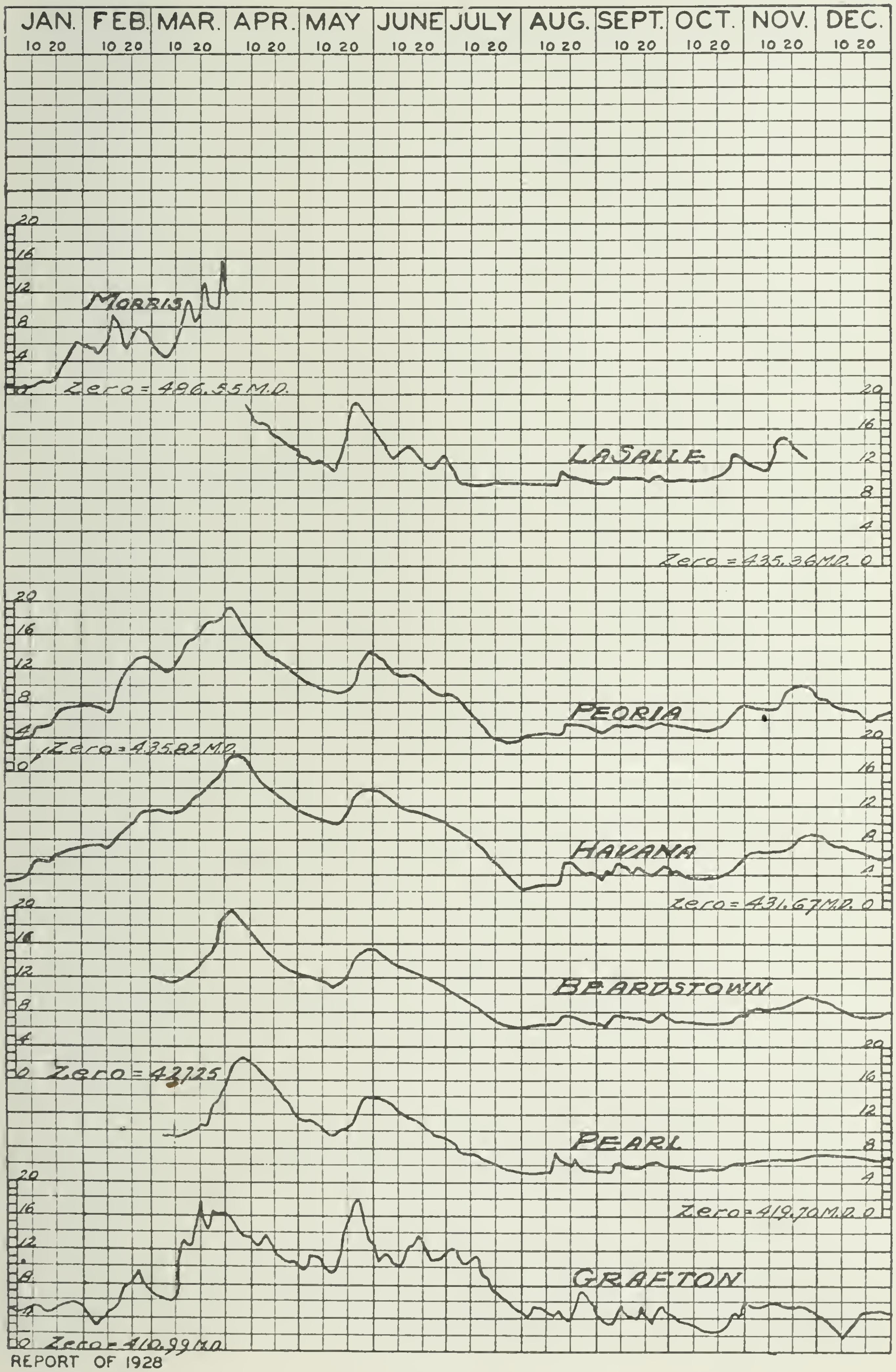

FIGURE B 19

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1899
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

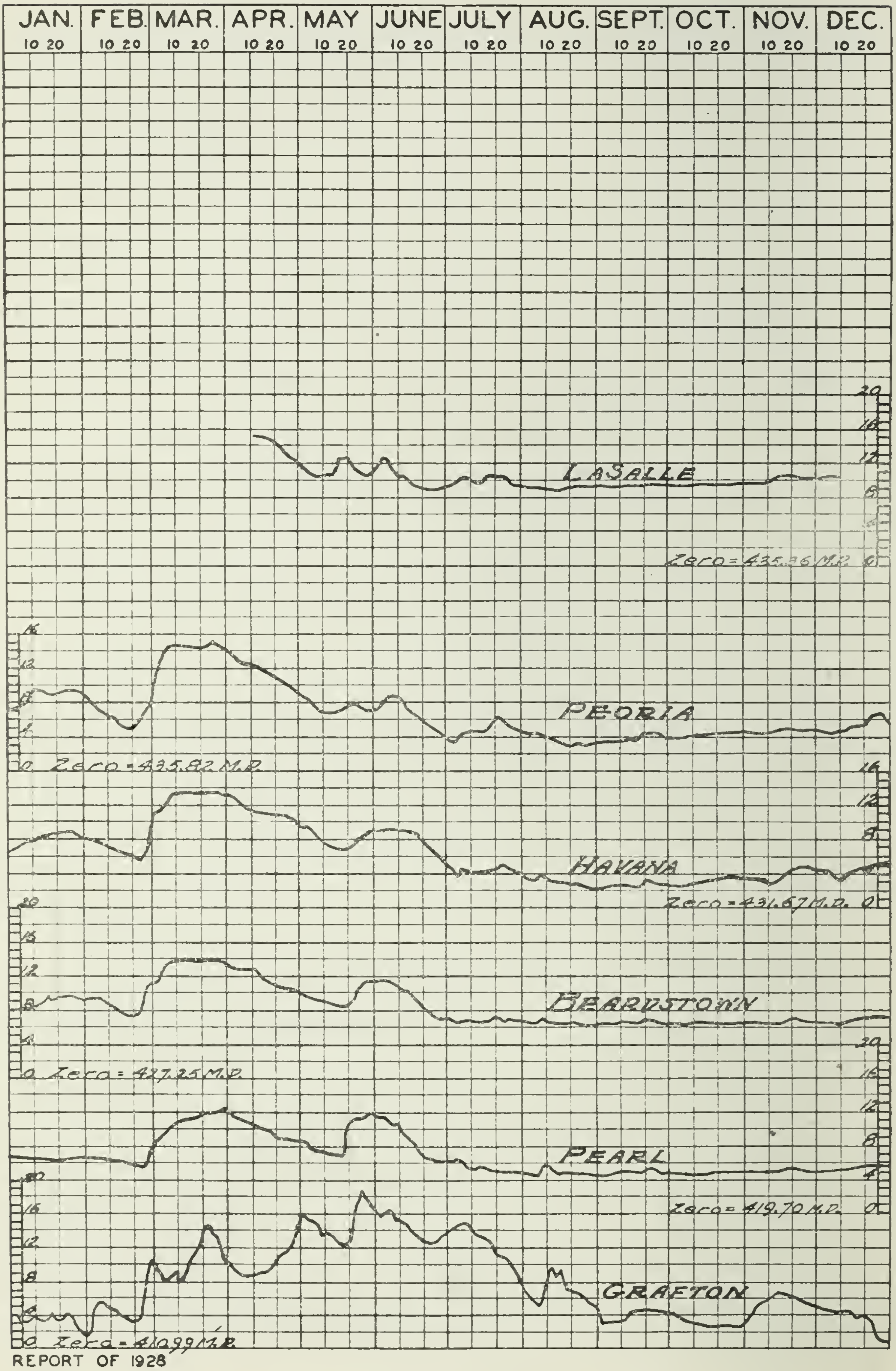

FIGURE B20

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1900
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

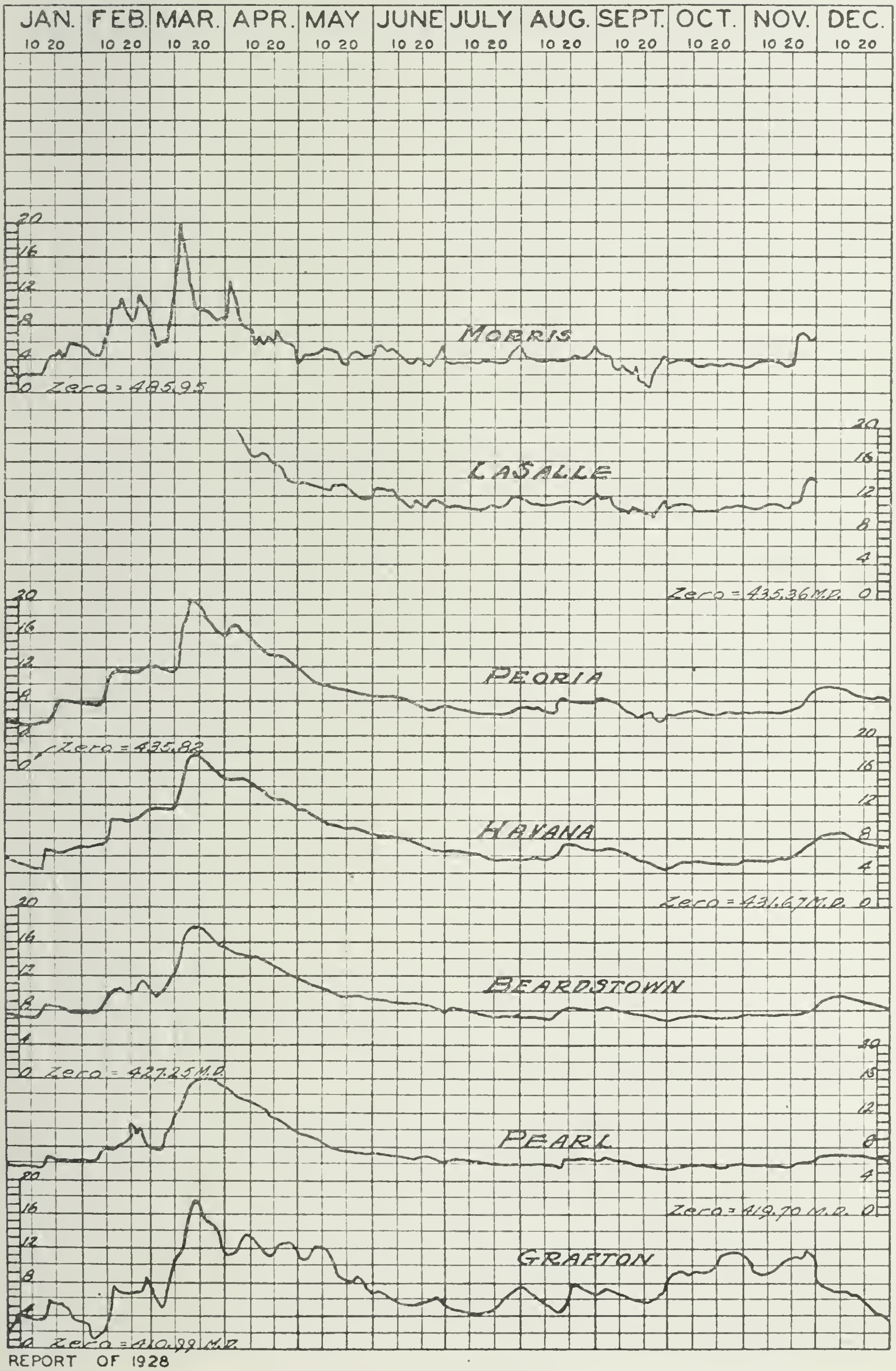

FIGURE B21

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1901
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

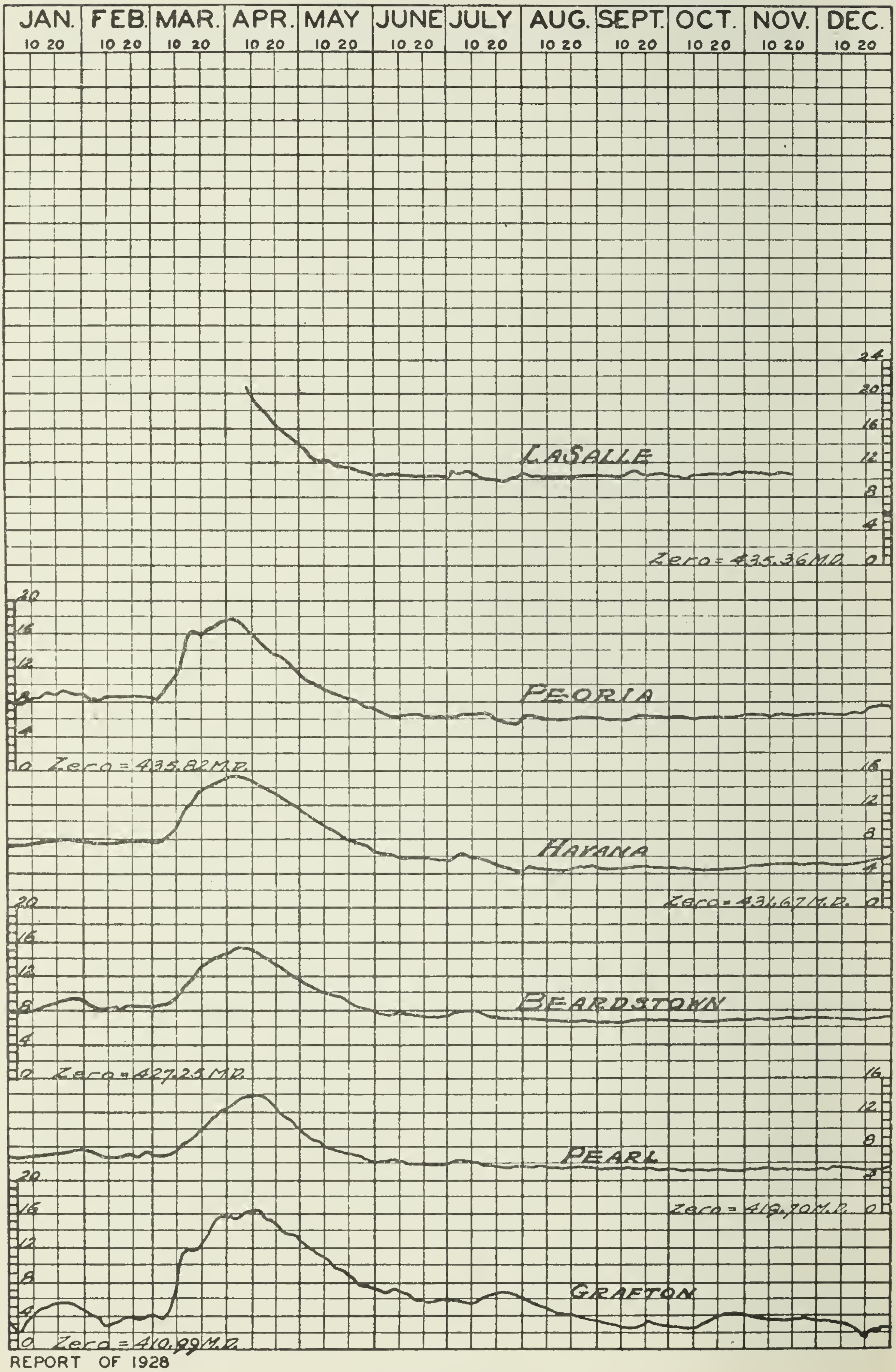

FIGURE B22

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1902
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

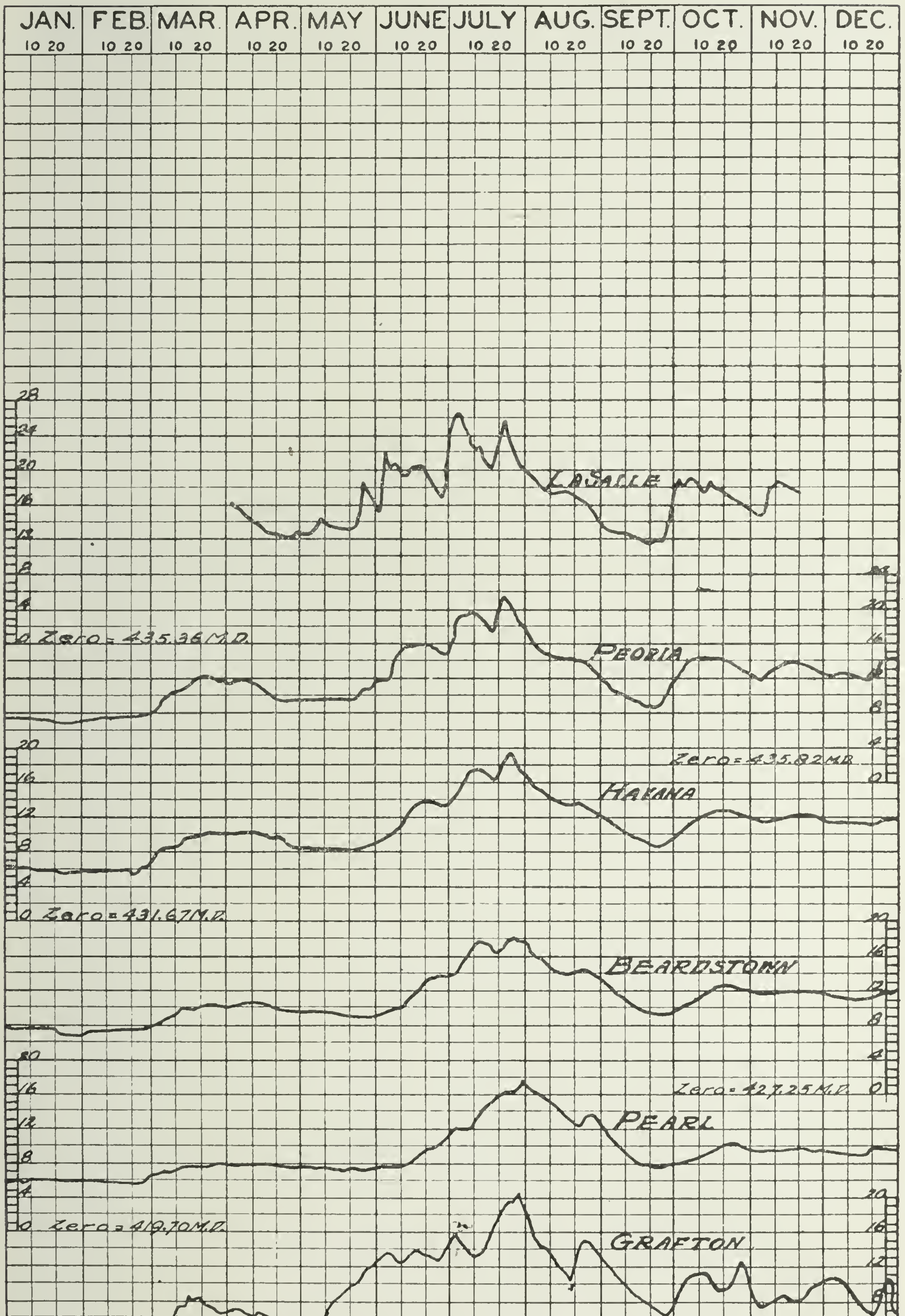

FIGURE B23

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1903
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

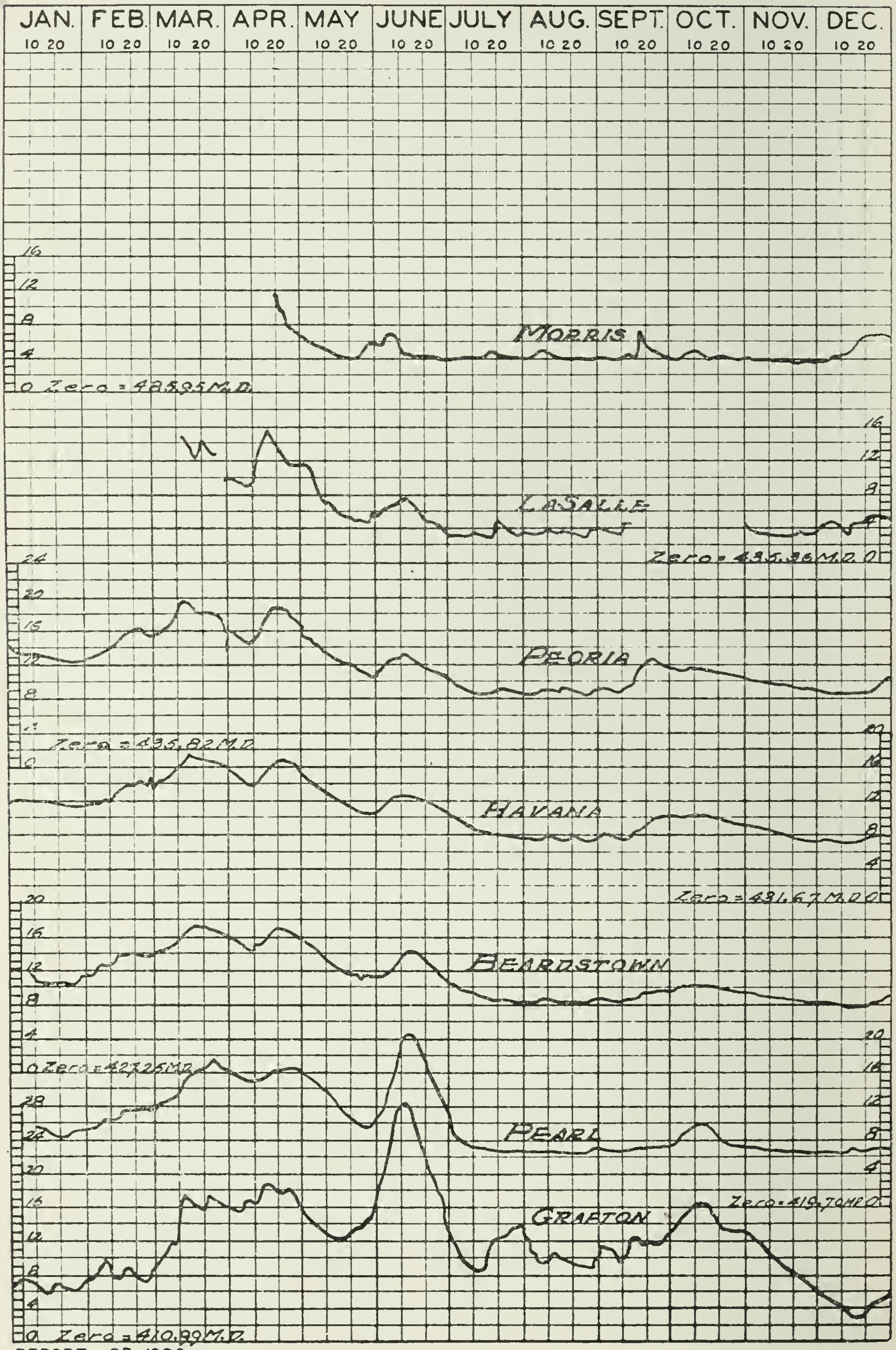

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FIGURE B24

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1904
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

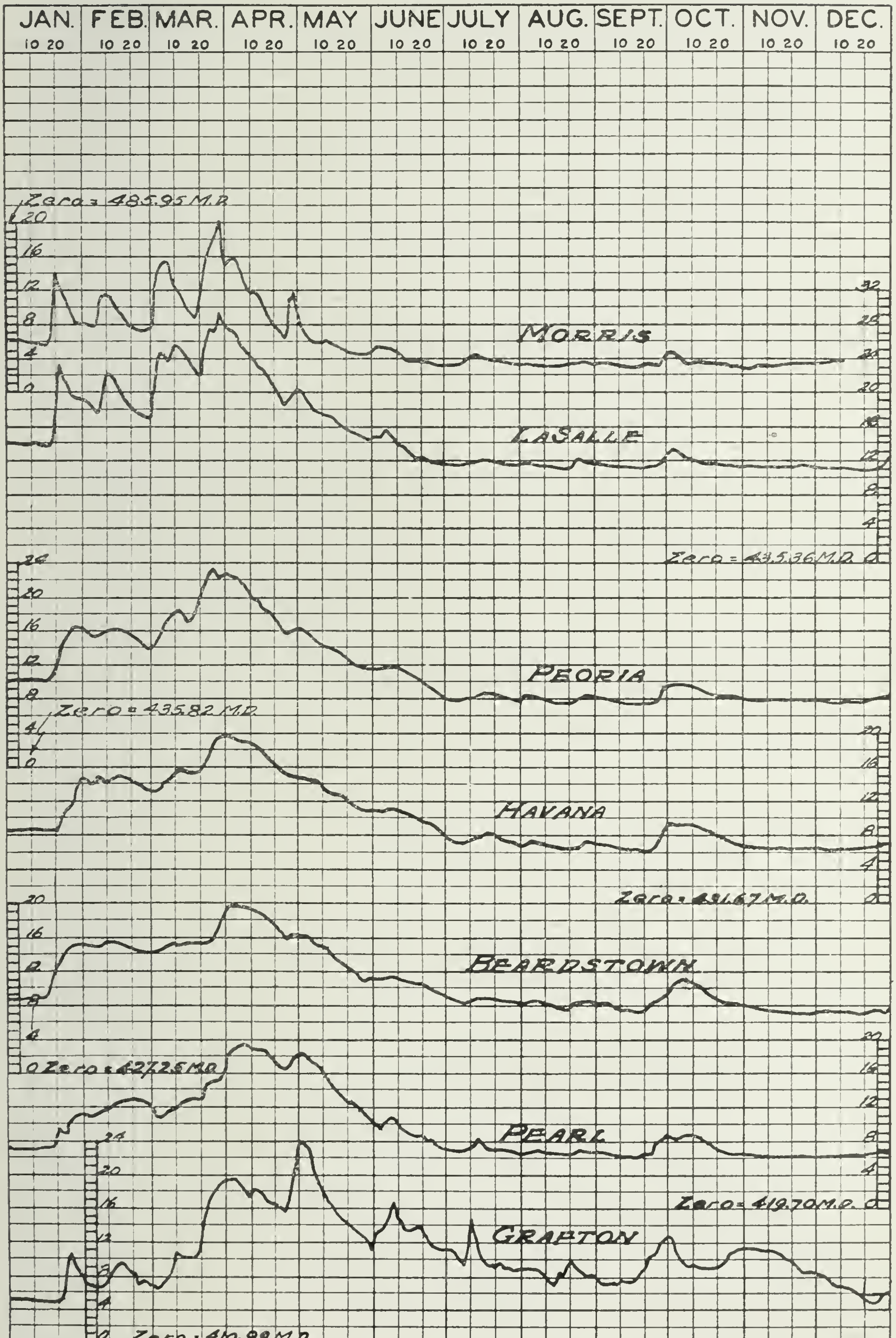

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FIGURE B25

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1905
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

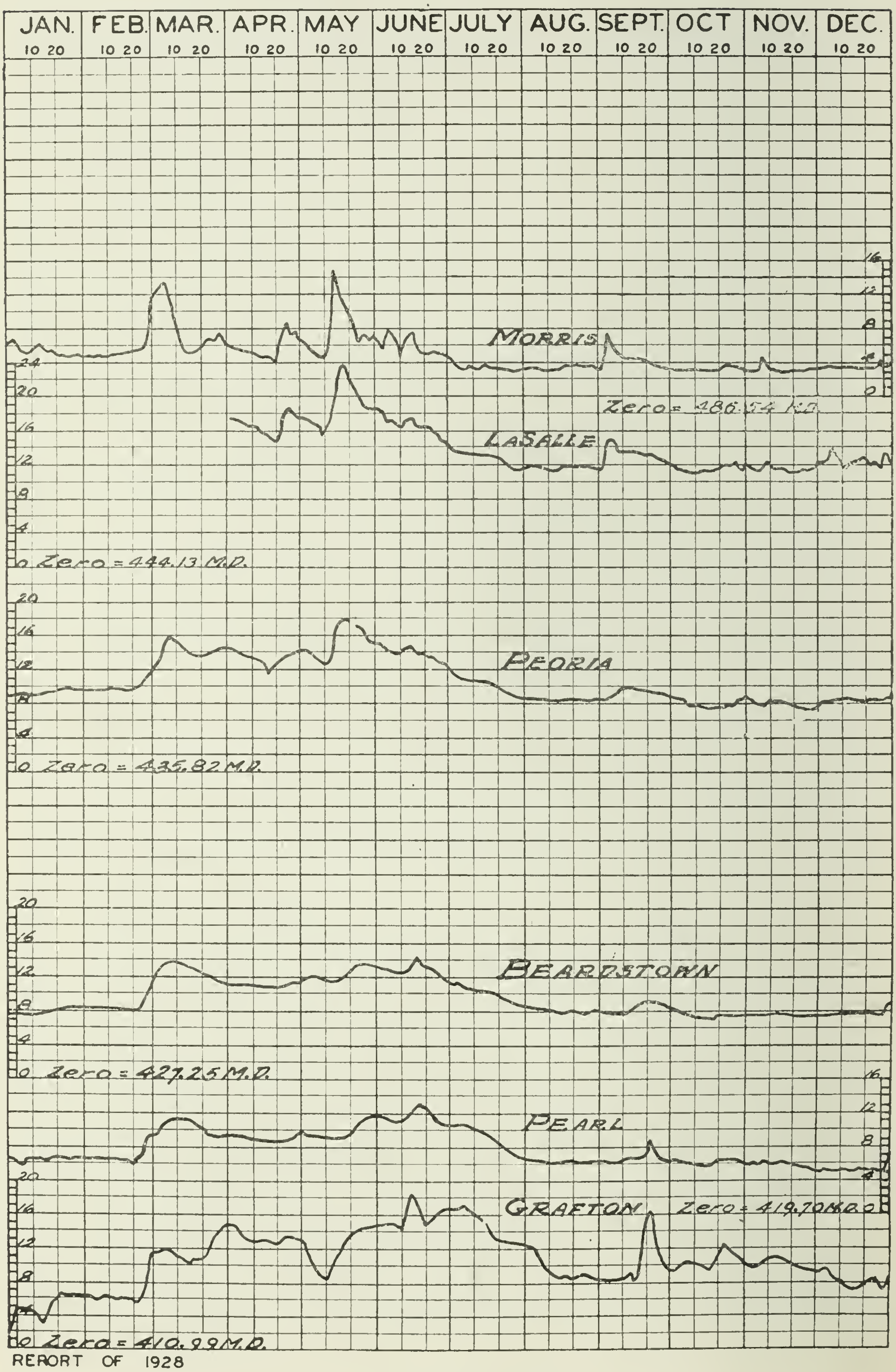

FIGURE B26

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1906
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

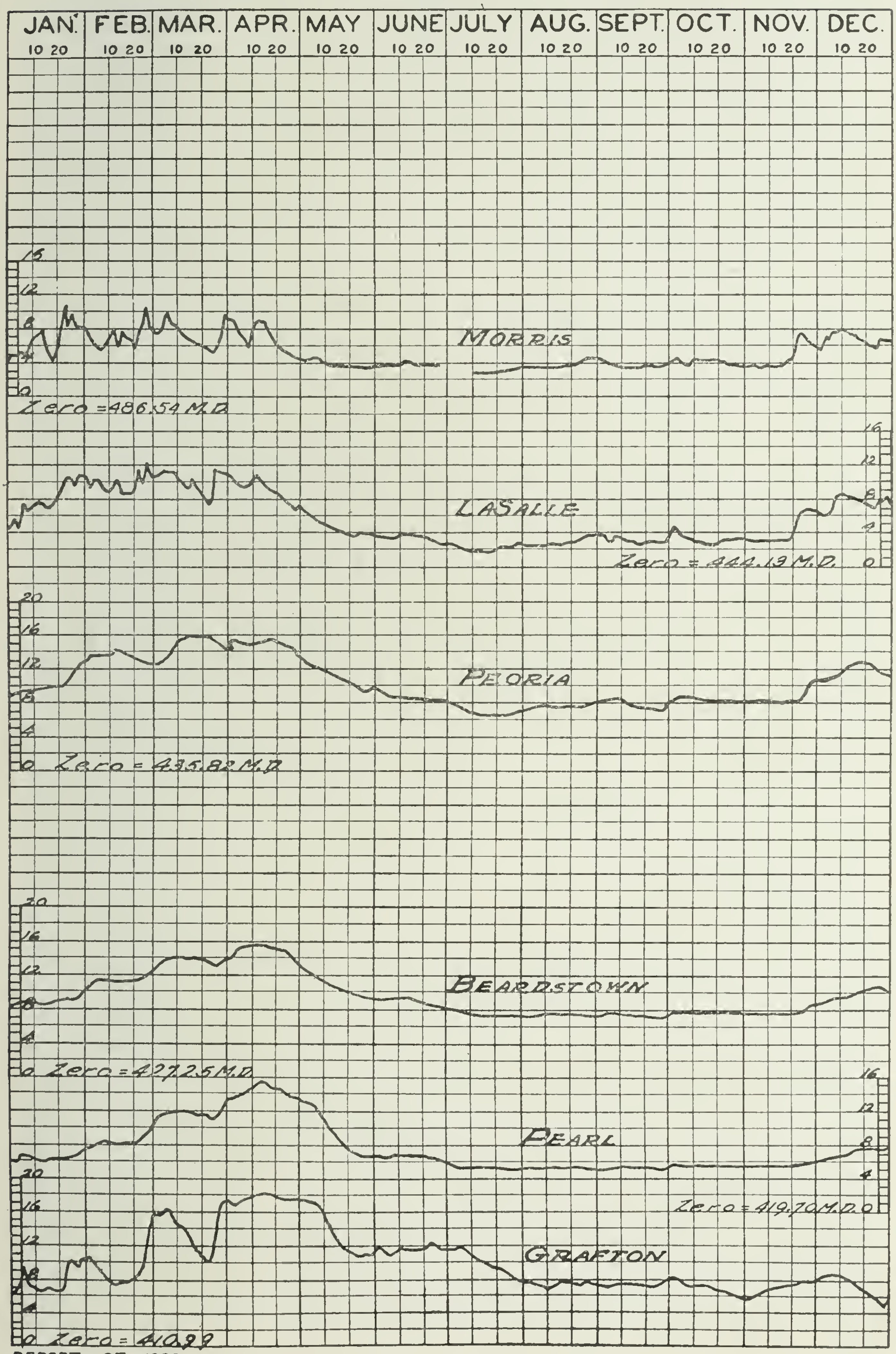

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FIGURE B27

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1907
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

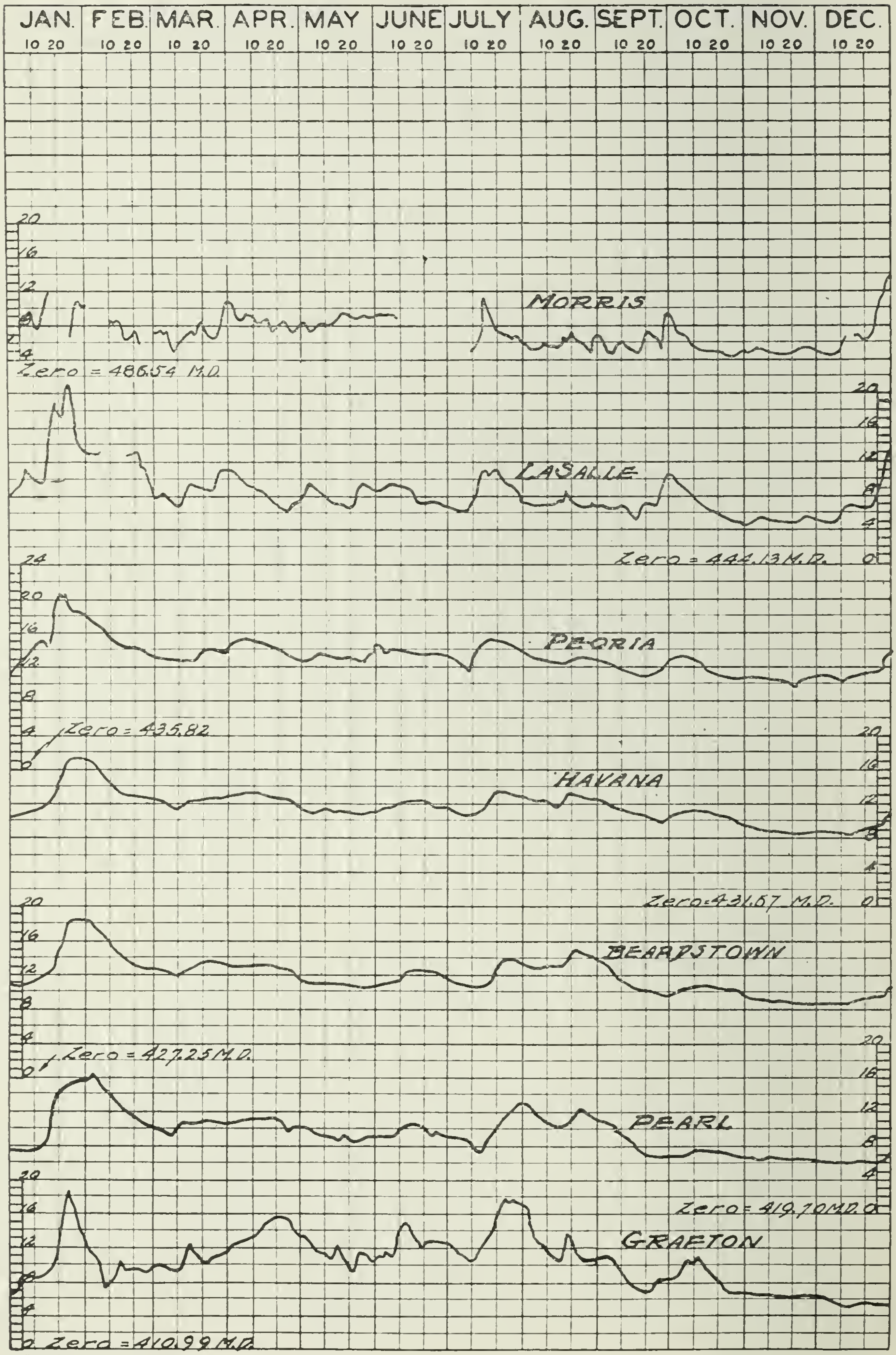

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FIGURE B28

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1908
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

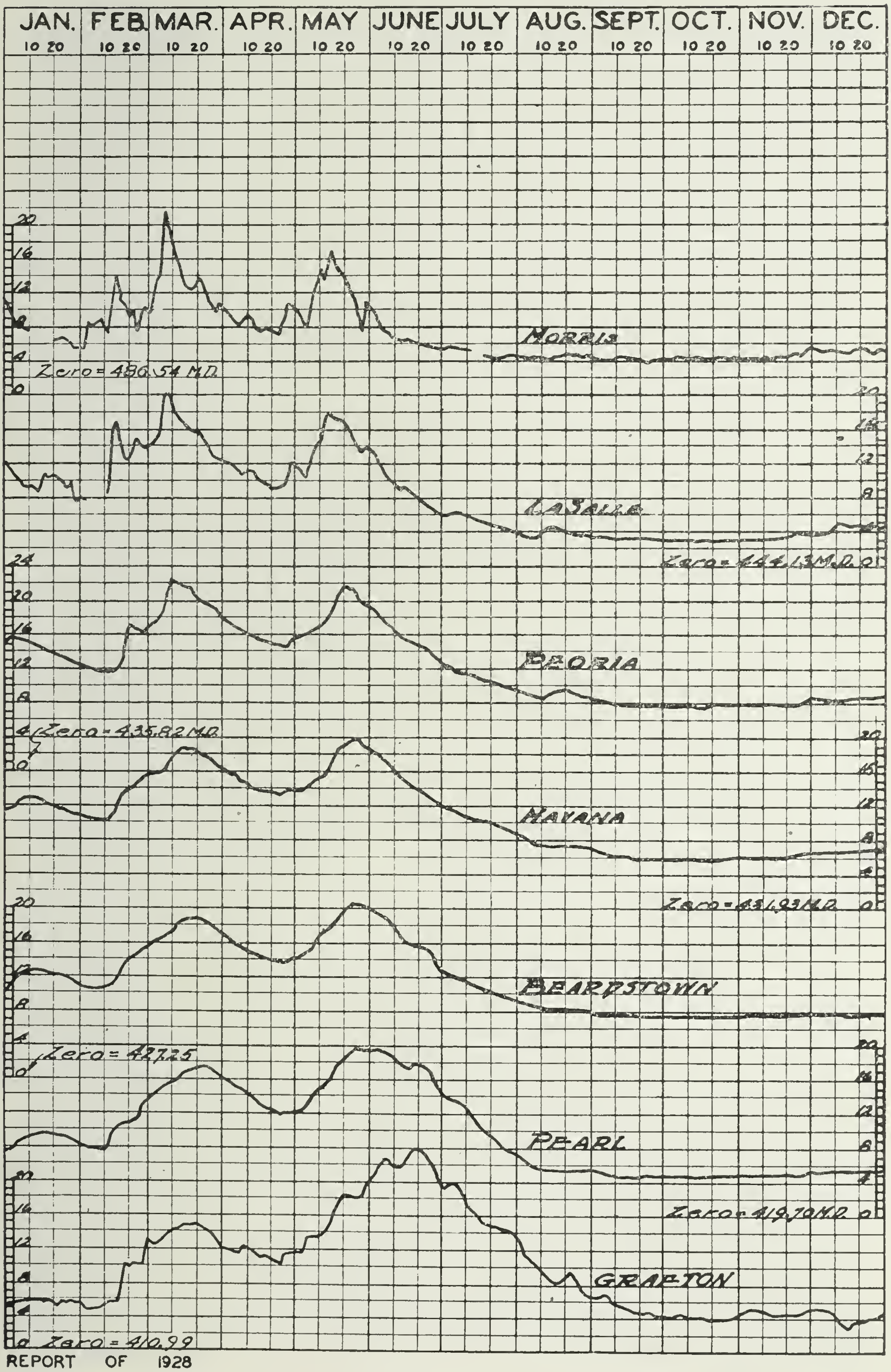
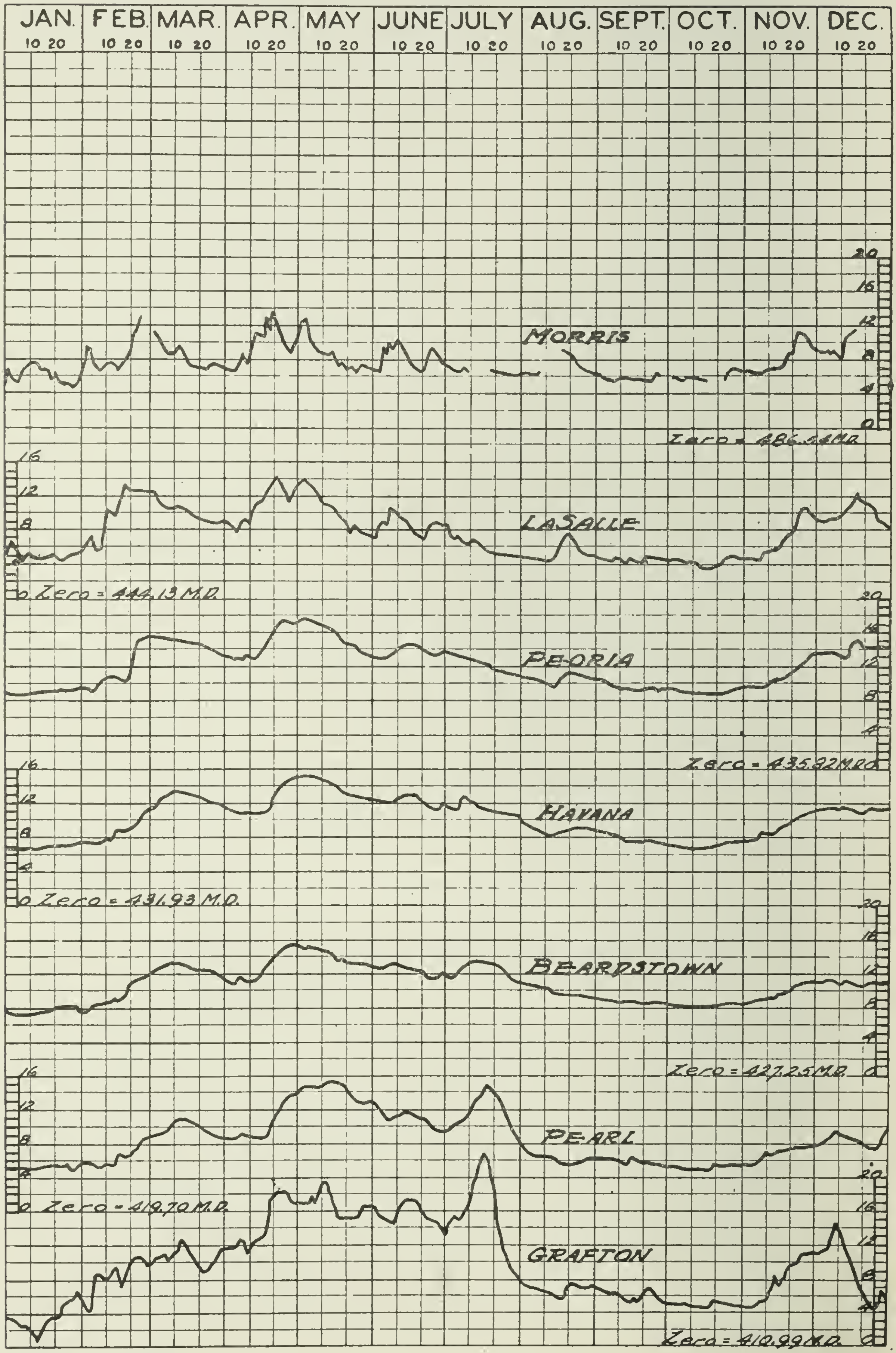


FIGURE B29

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1909
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B30

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1910
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

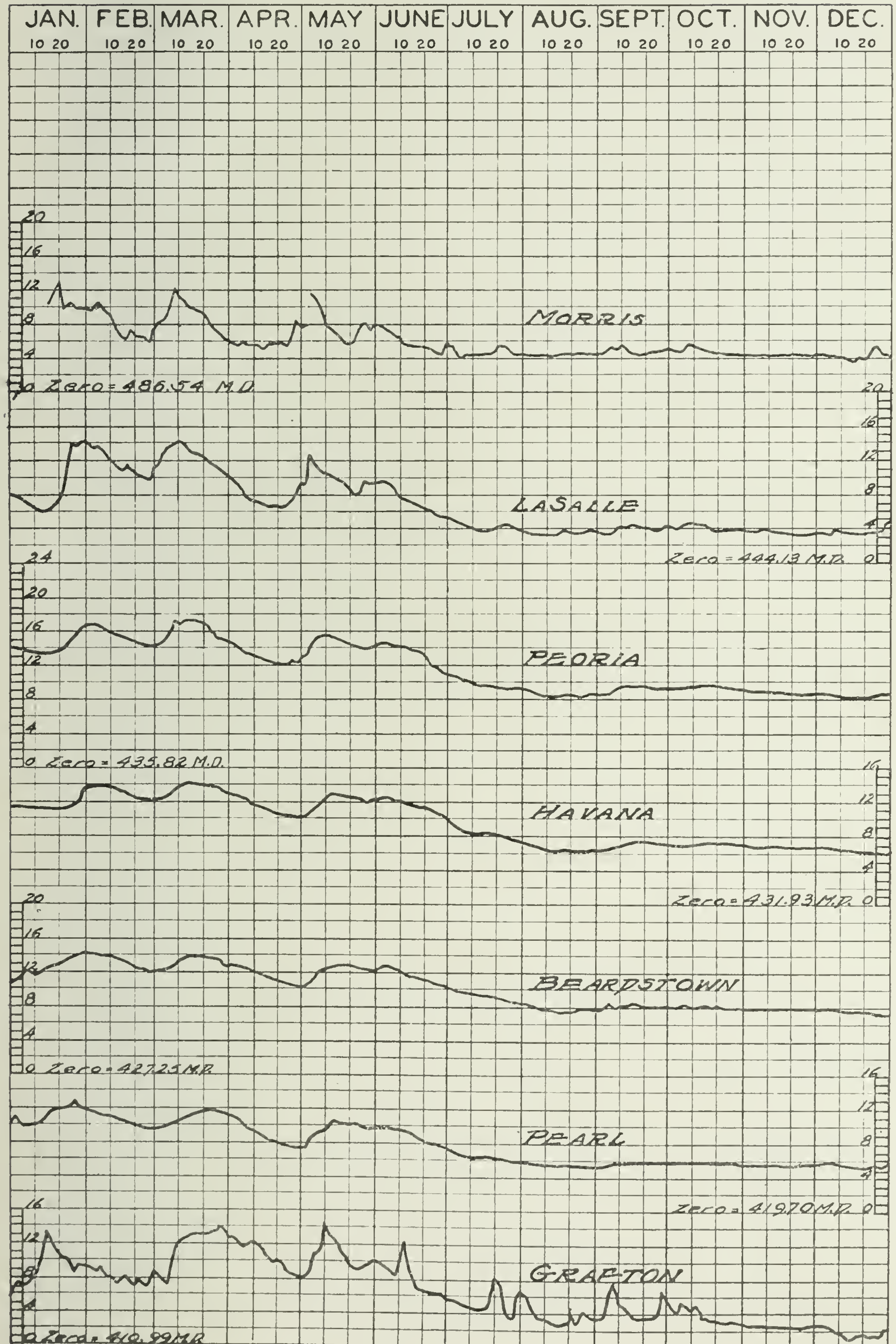


FIGURE B31

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1911
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

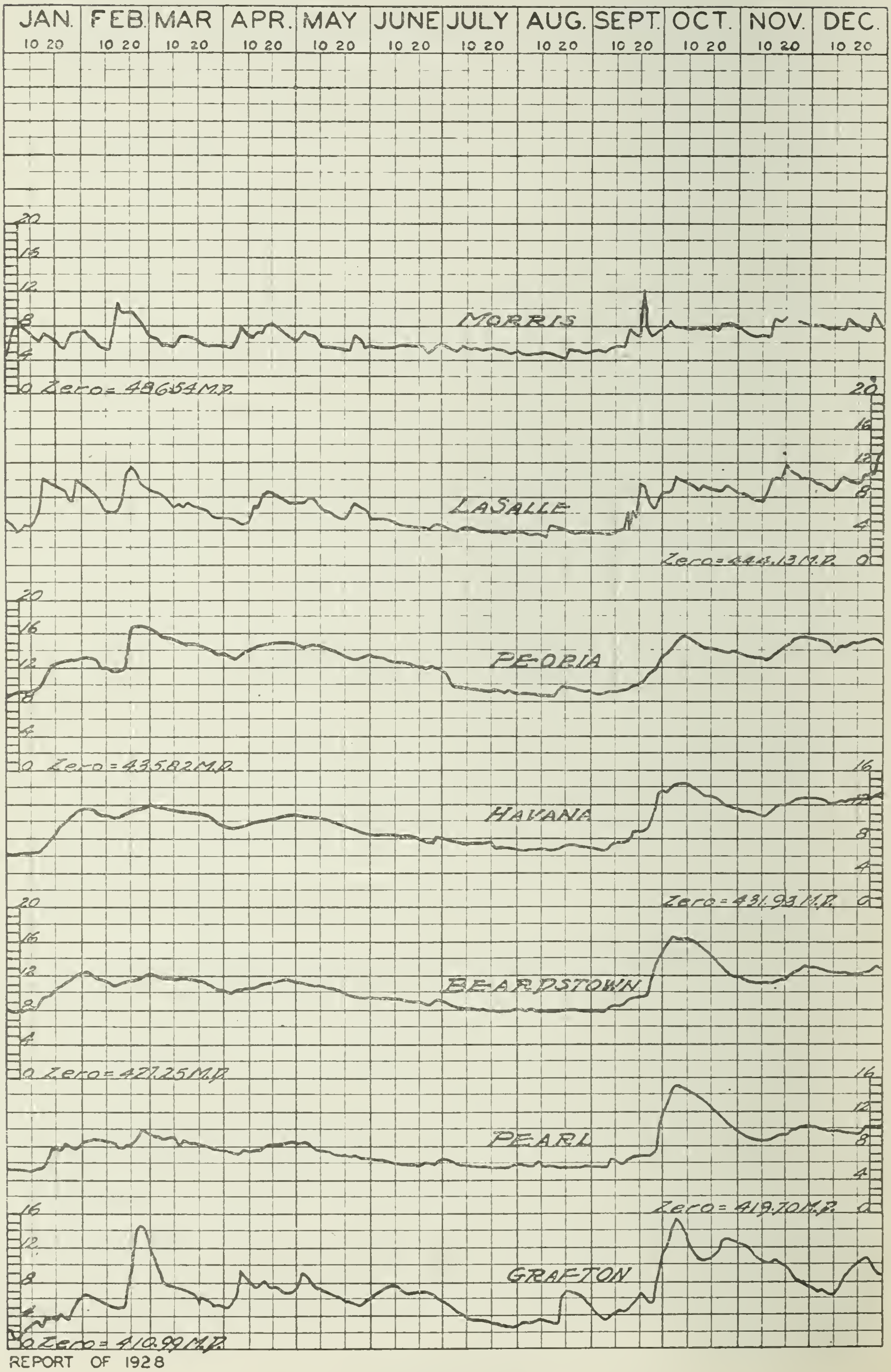


FIGURE B32

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1912
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

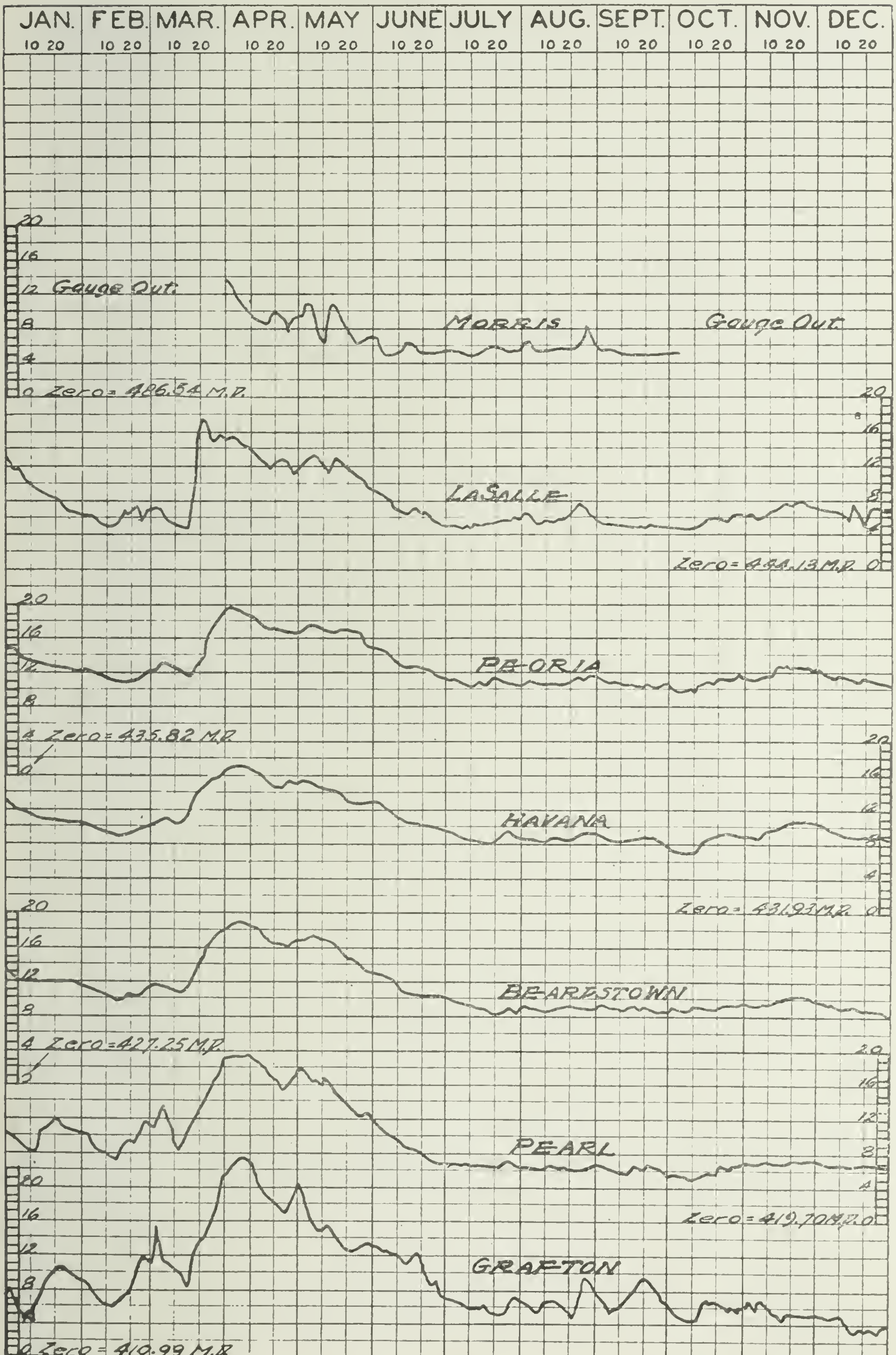


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FIGURE B33

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1913
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

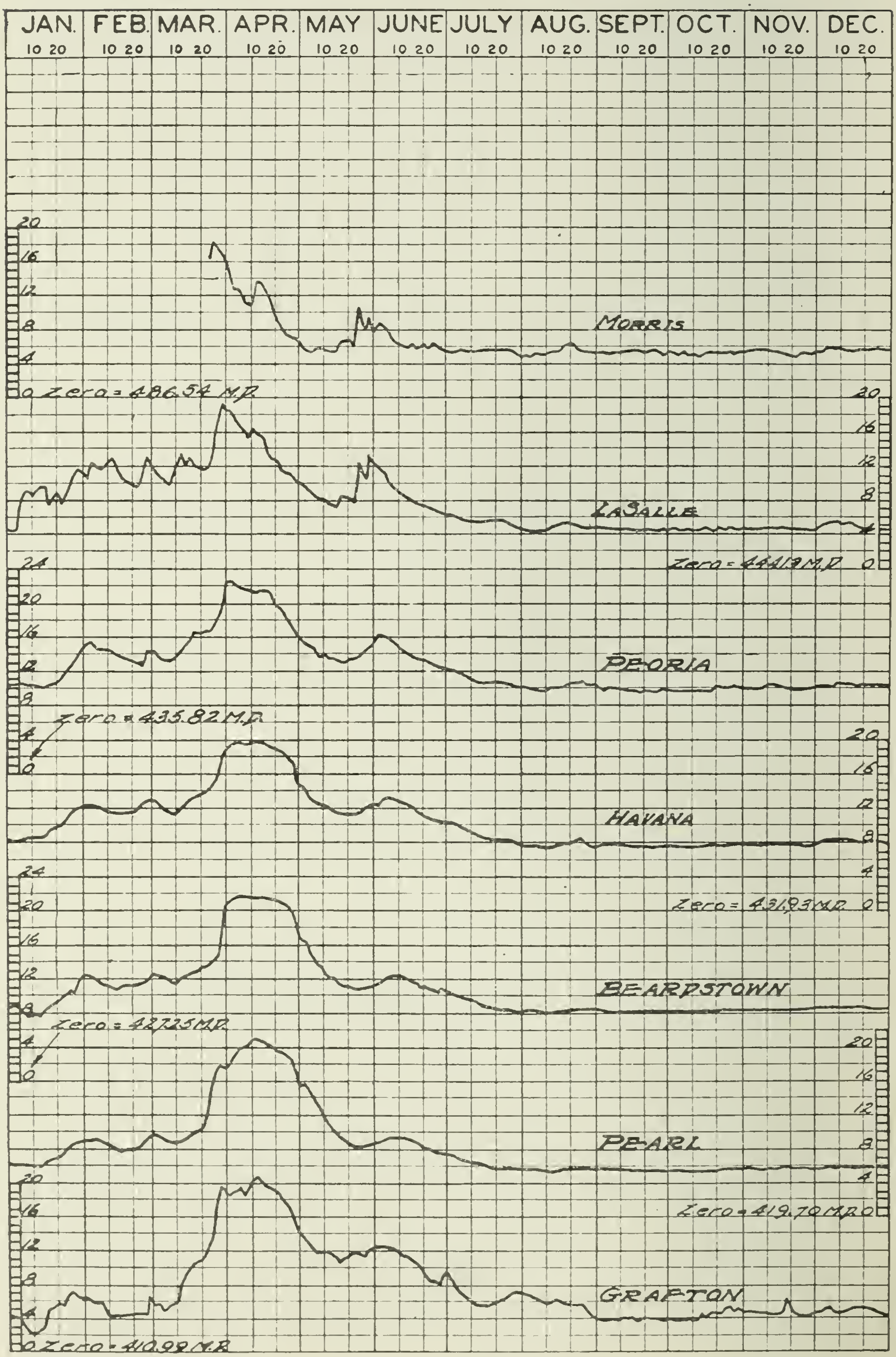

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FIGURE B34

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1914
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

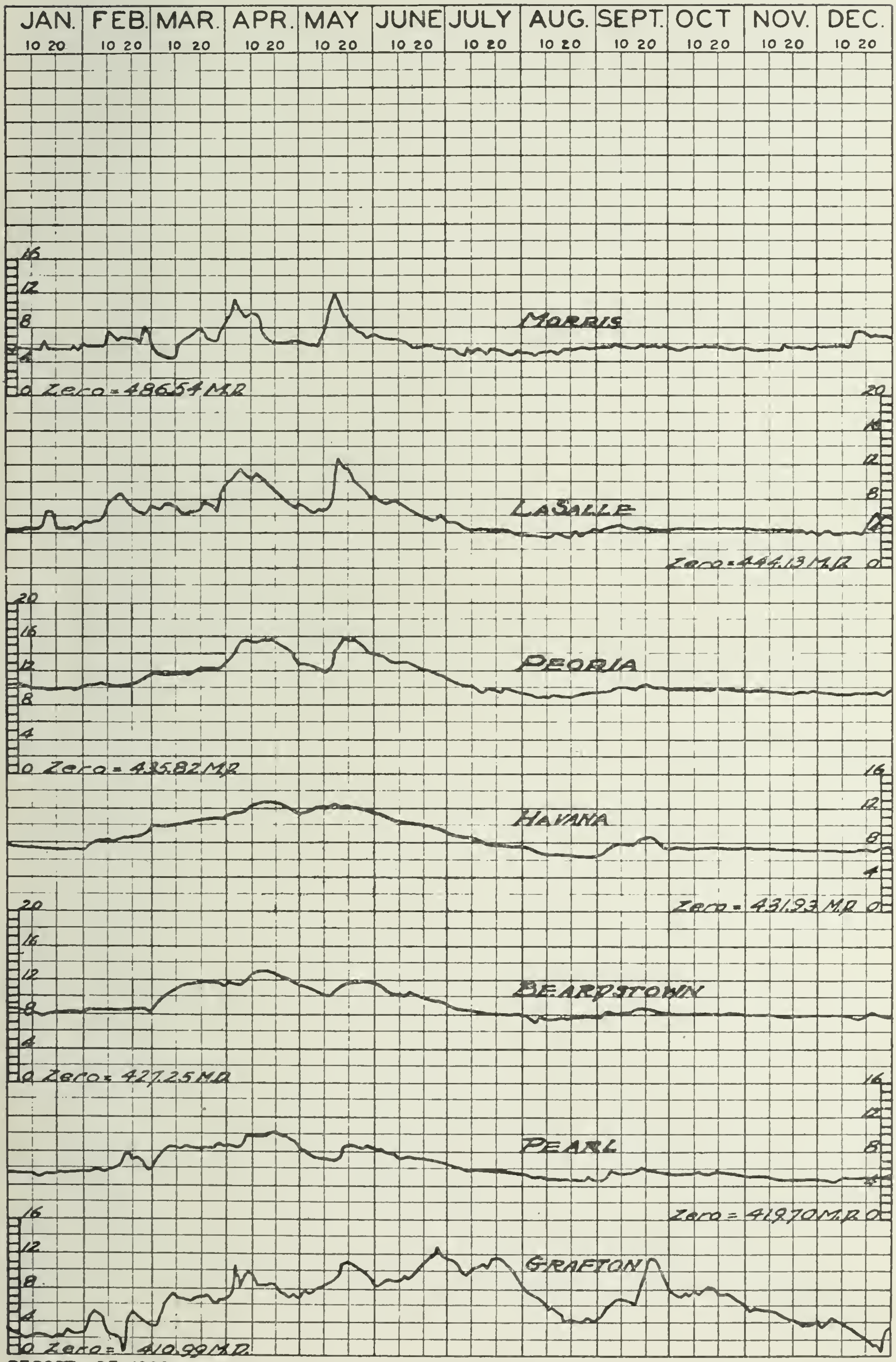

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FIGURE B35

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1915
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

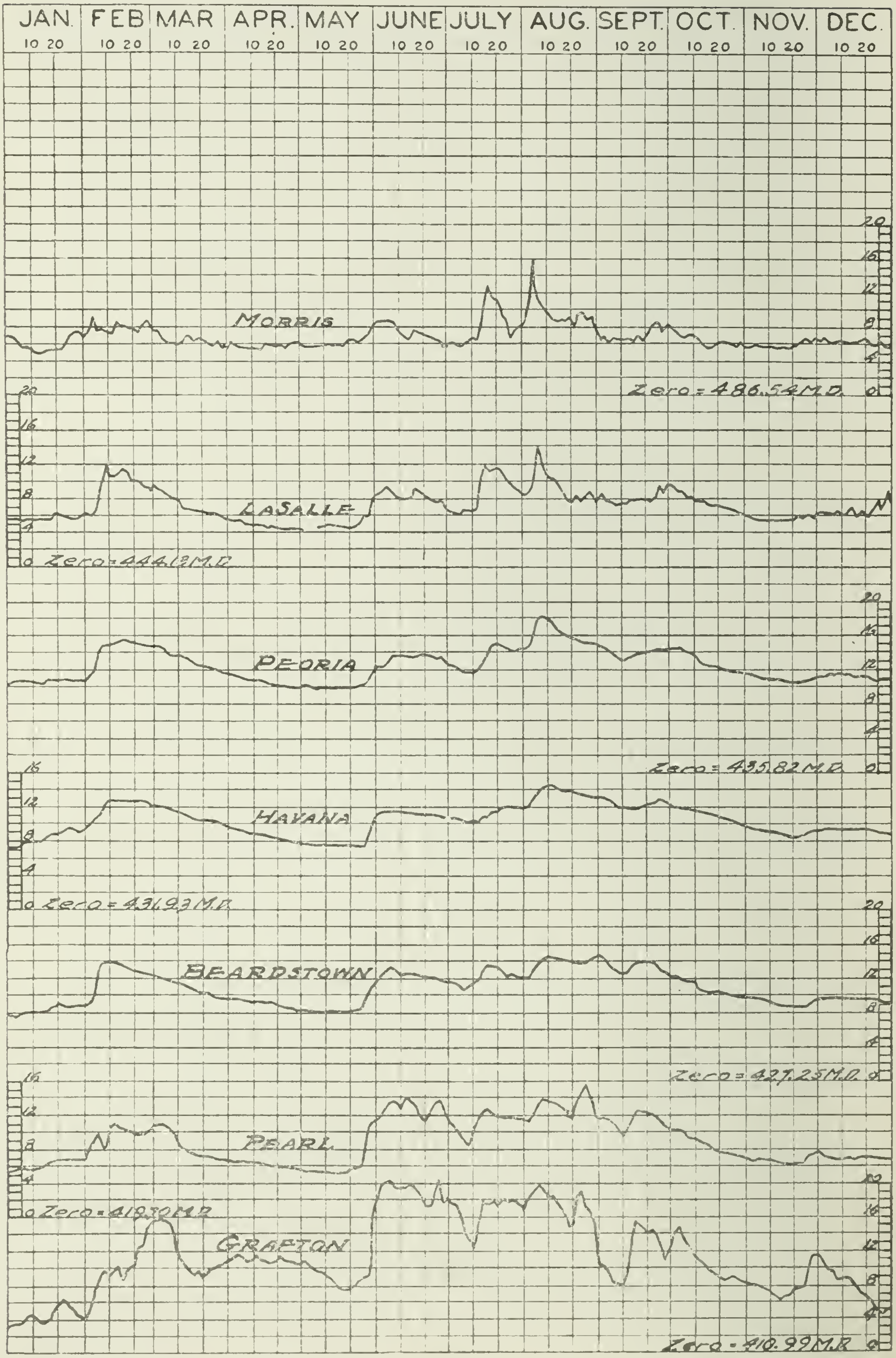

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FIGURE B 36

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1916
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

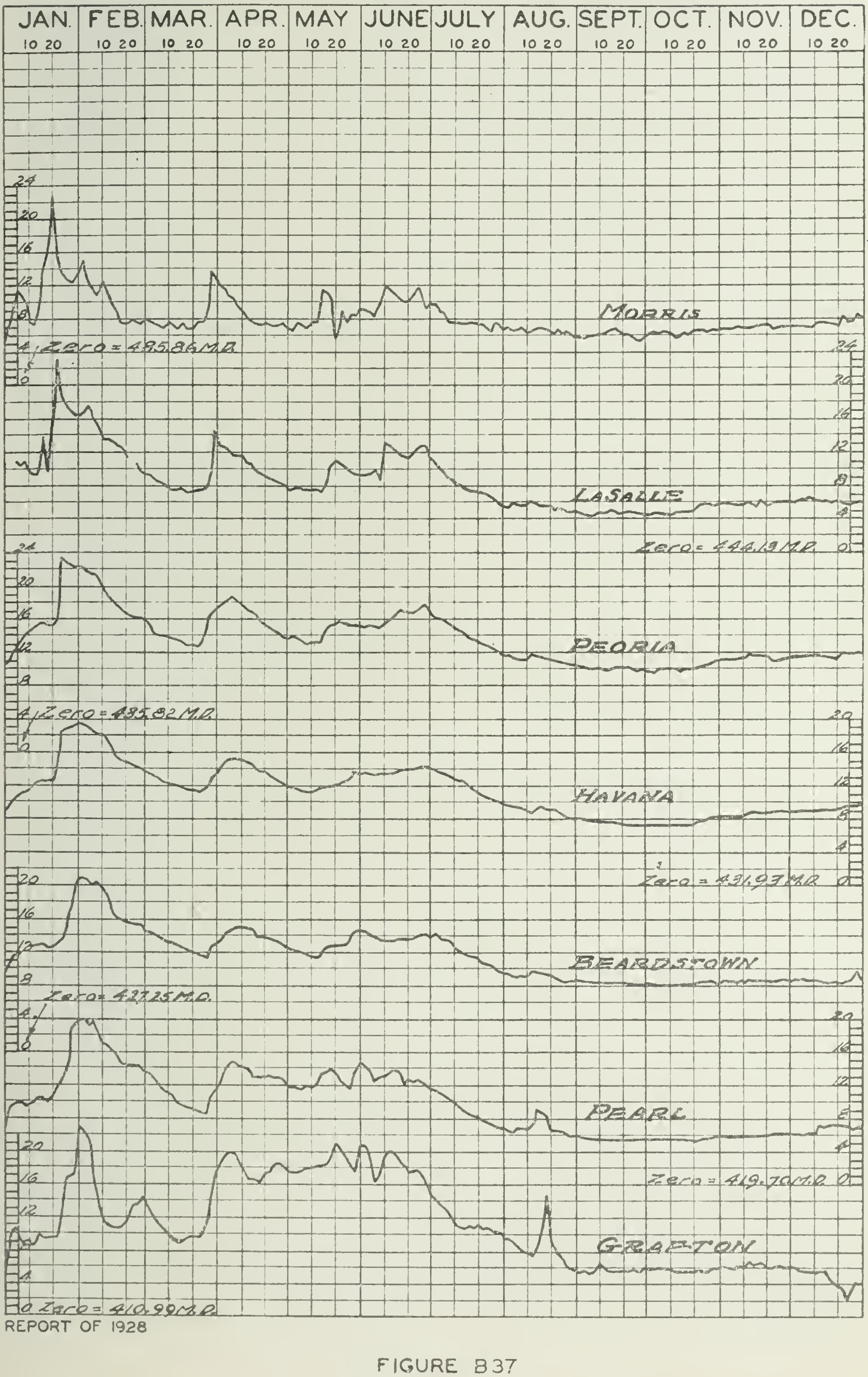
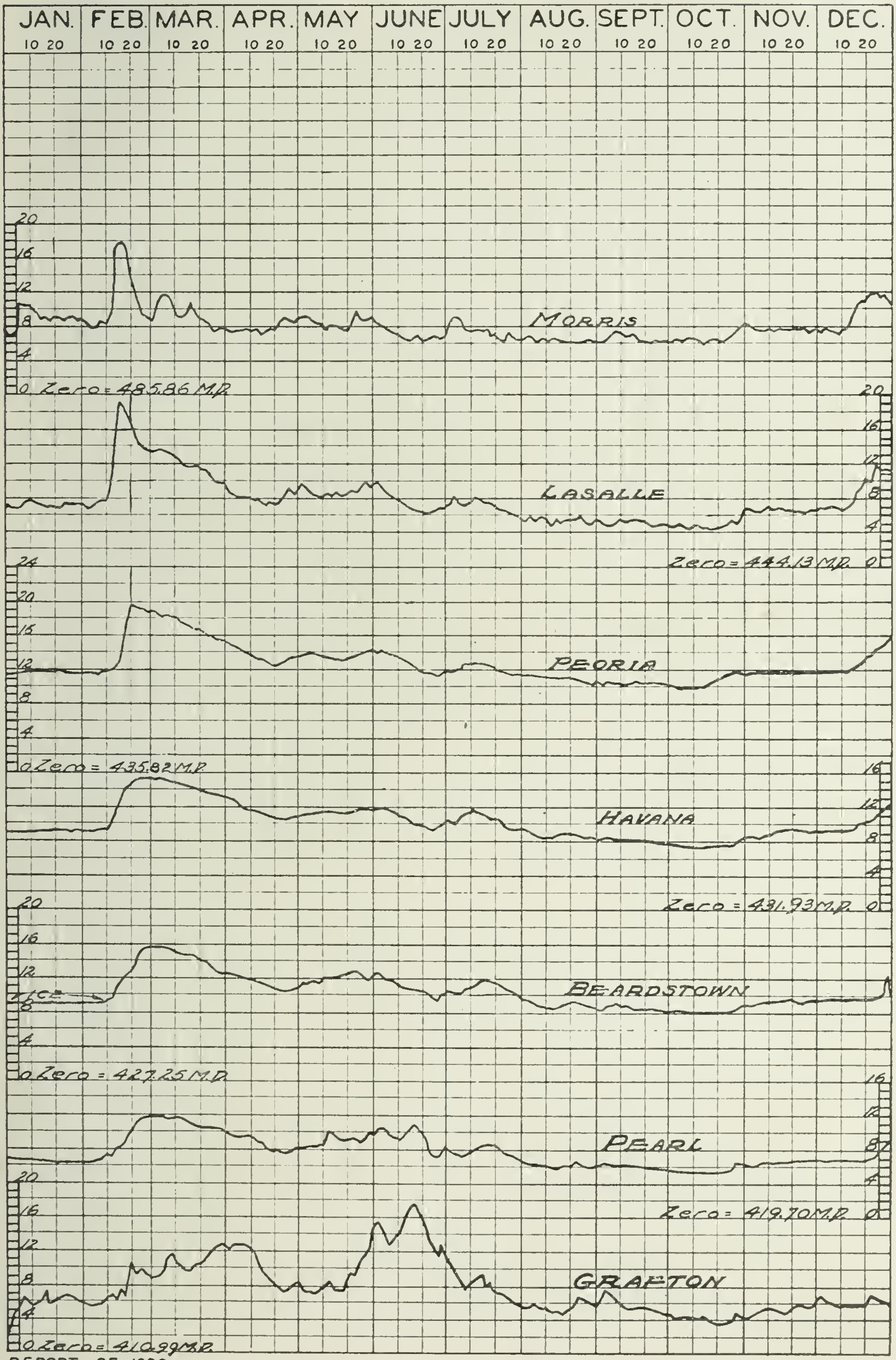


FIGURE B37

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1917
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

FIGURE B38

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1918
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



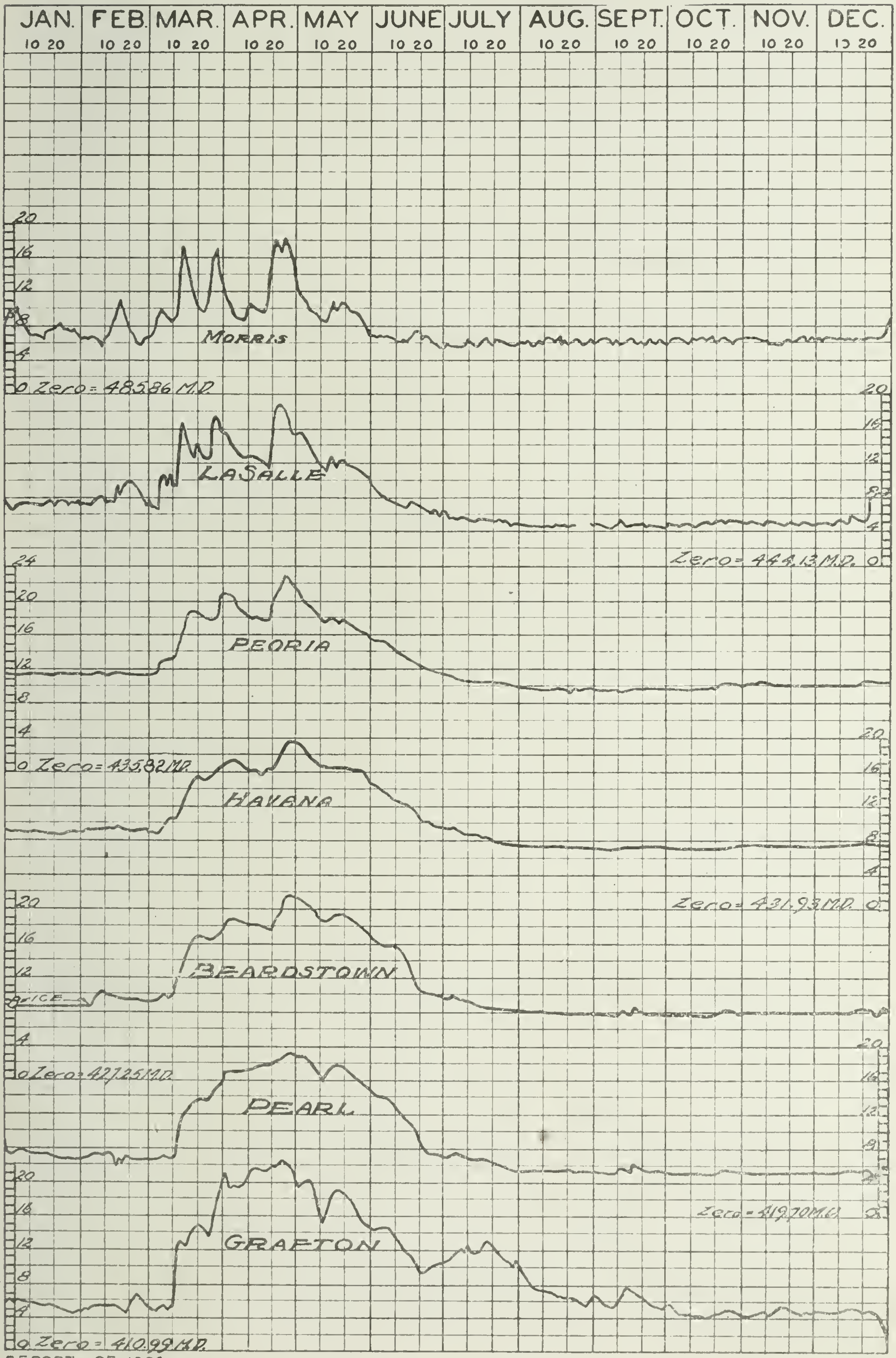
REPORT OF 1928

FIGURE B 39

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1919
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

FIGURE B 40

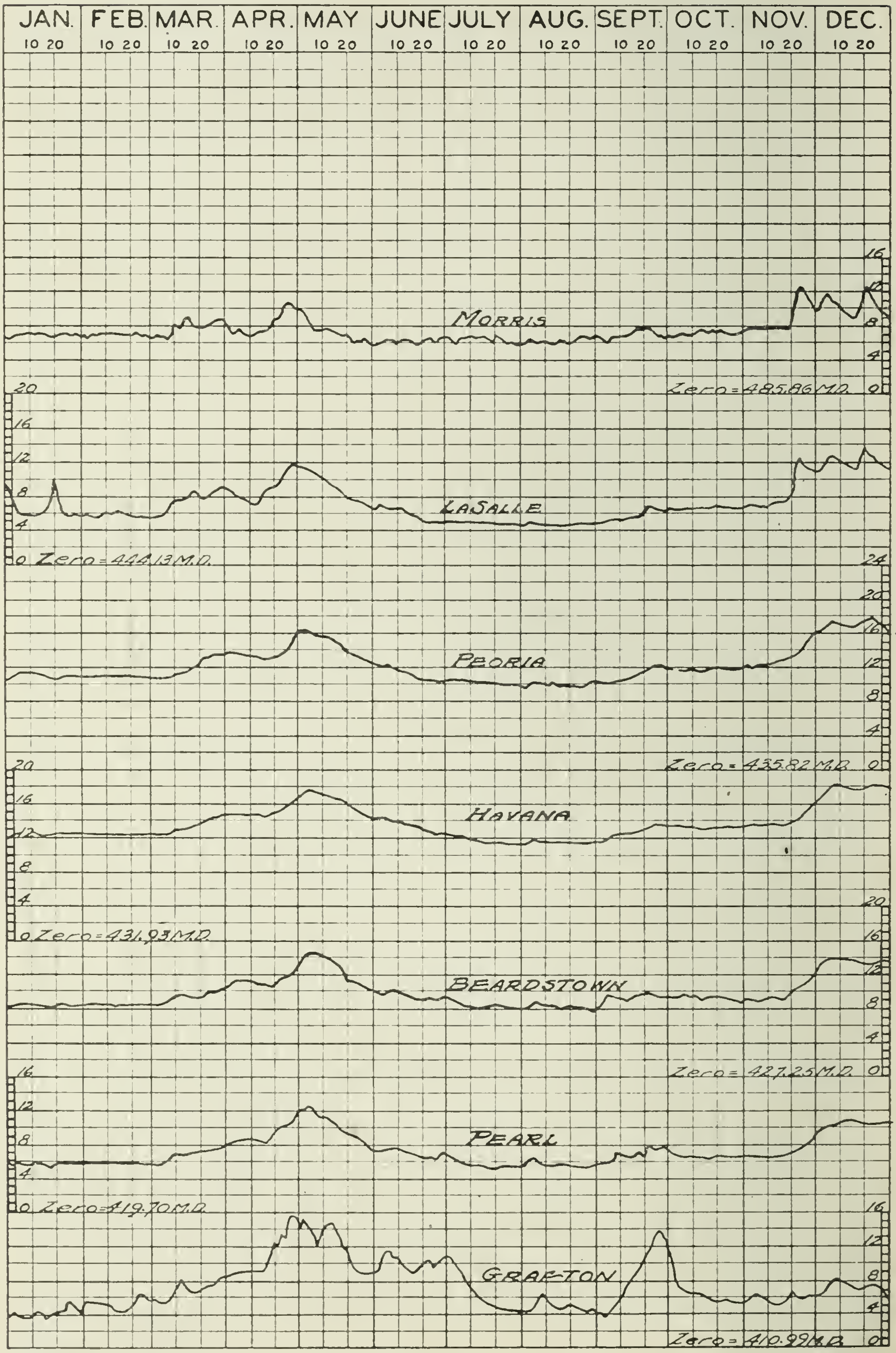
HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1920
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B 41

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1921
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer

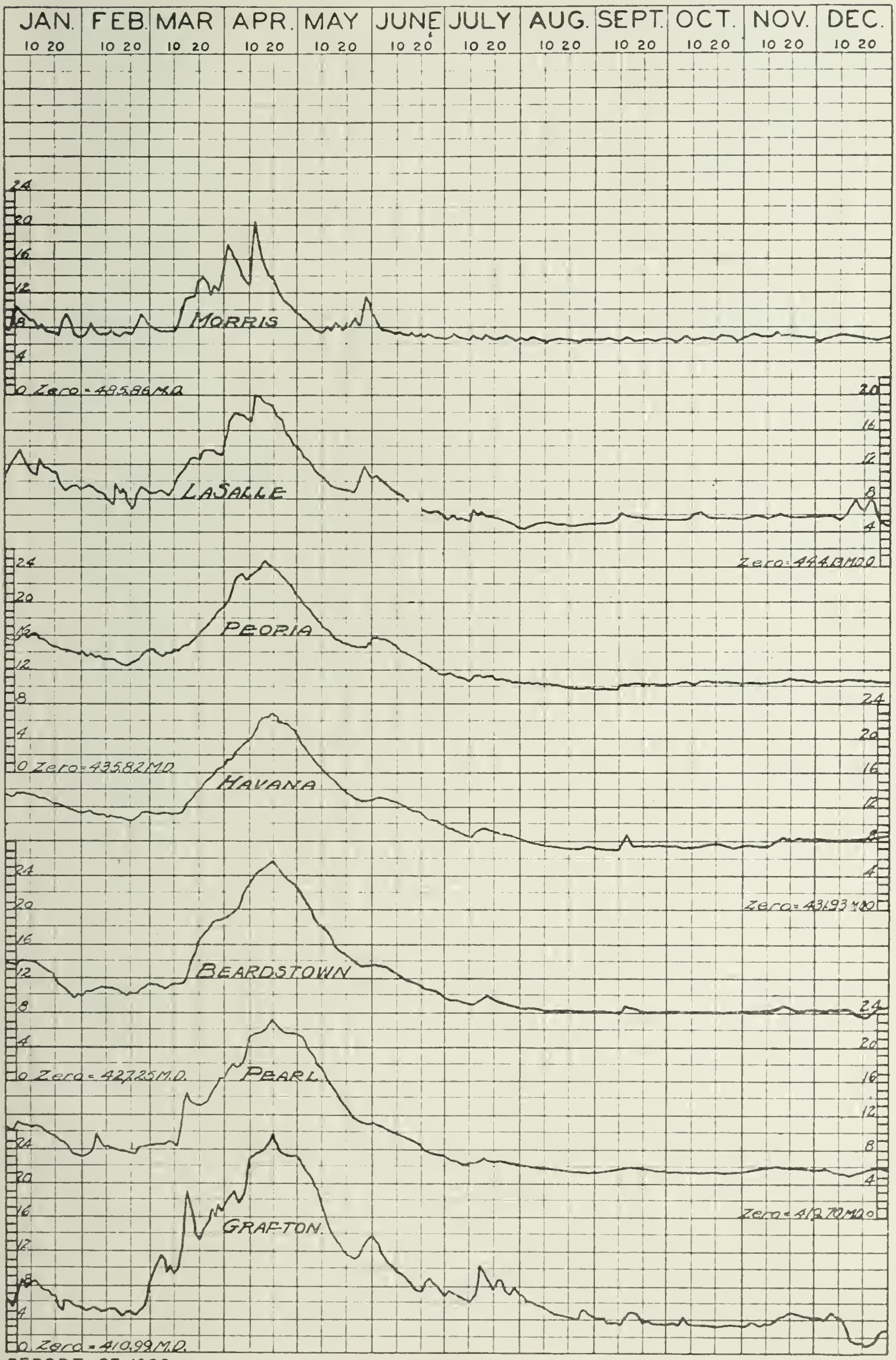


REPORT OF 1928

FIGURE B42

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1922
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS

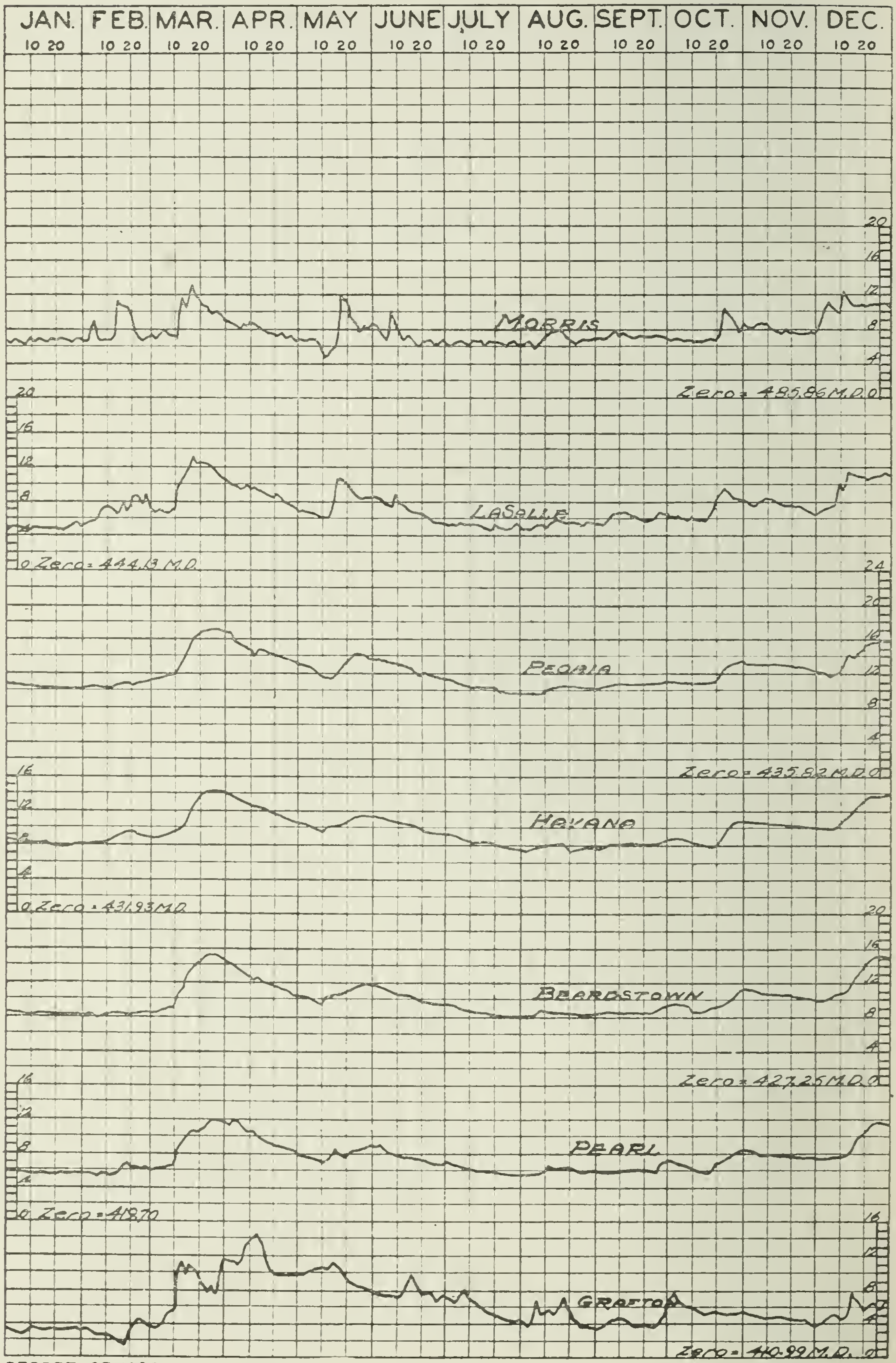
By Jacob A. Harman, Consulting Engineer



REPORT OF 1928

FIGURE B 43

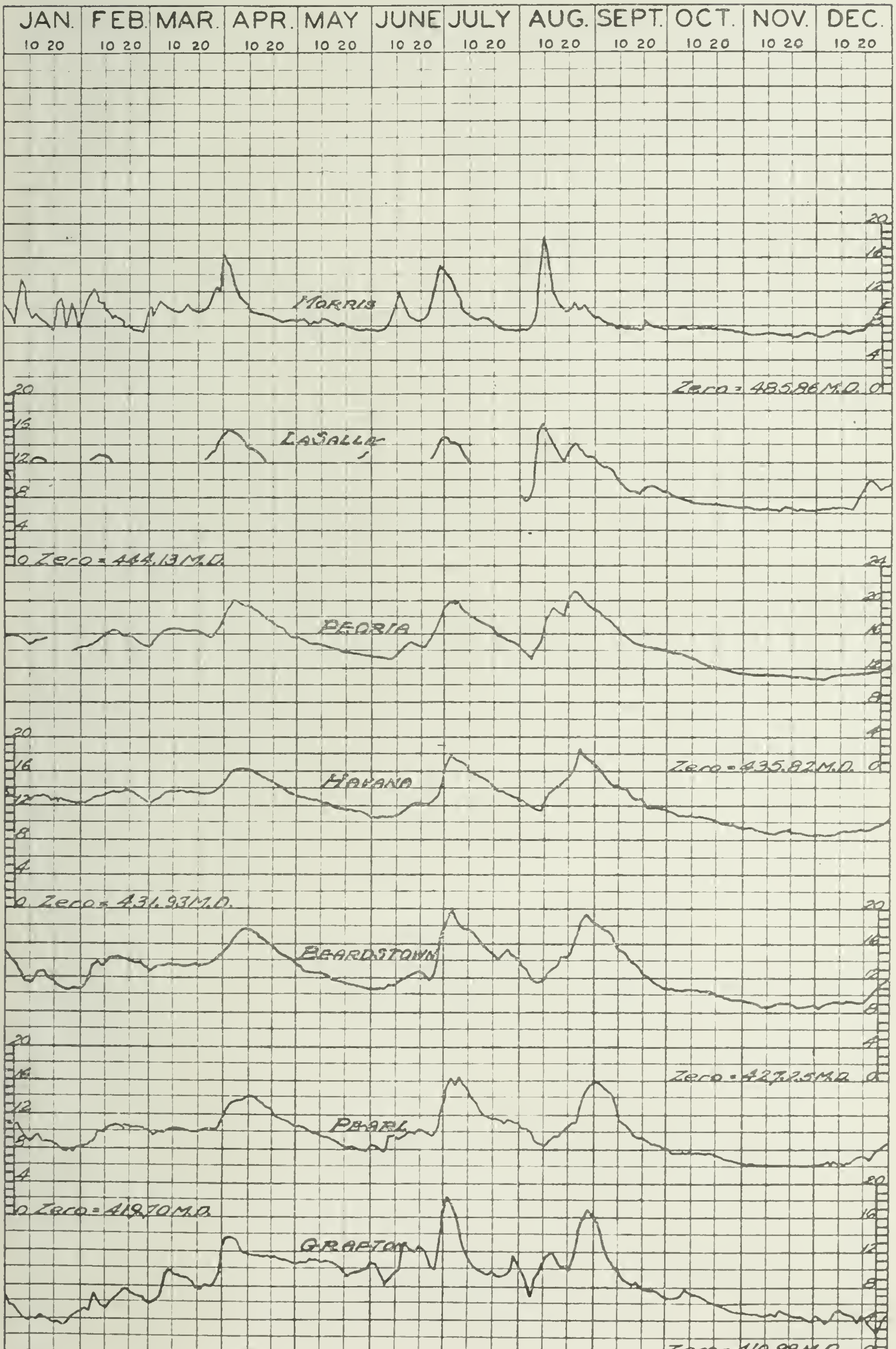
HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1923
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B44

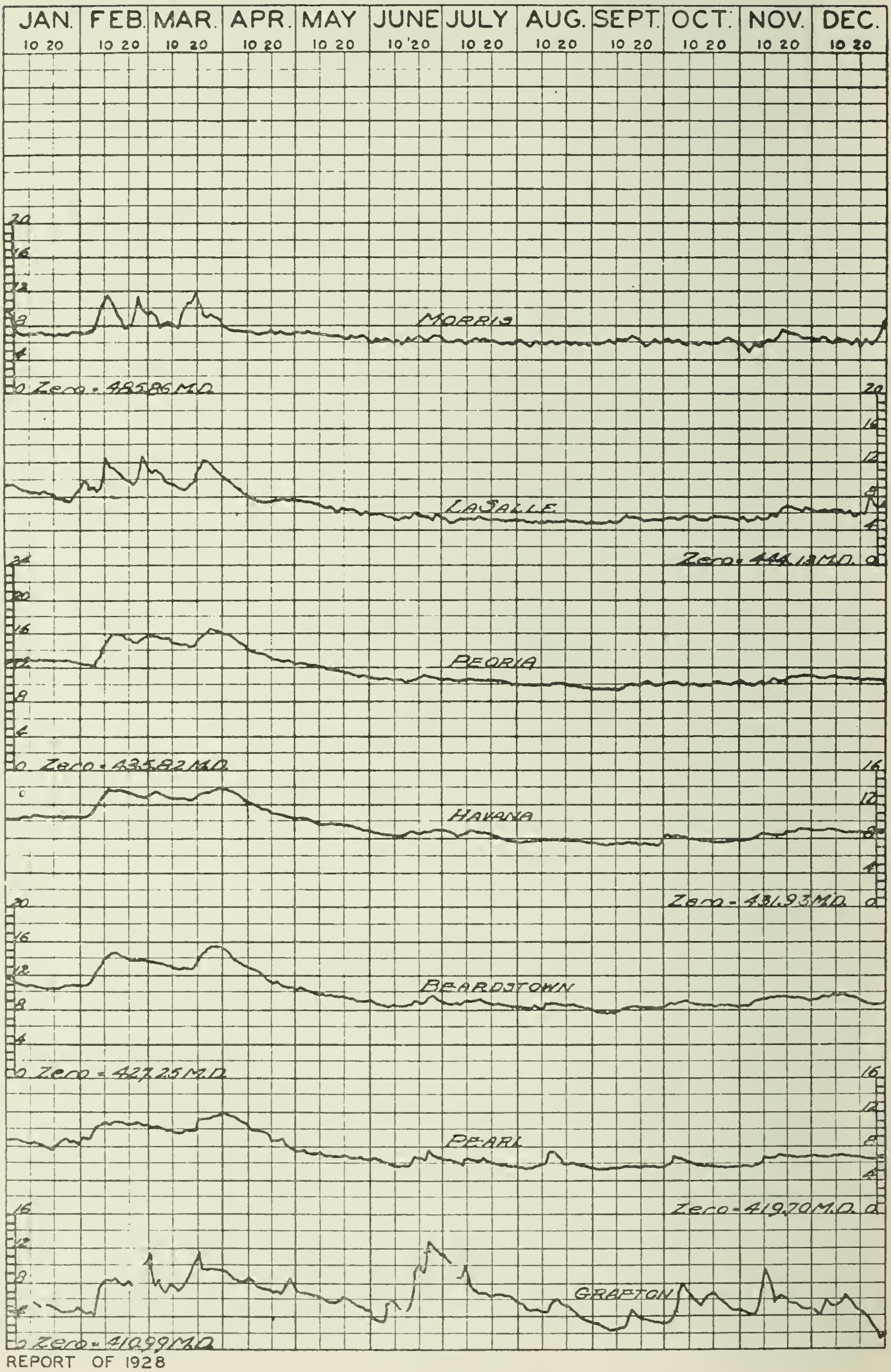
HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1924
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B45

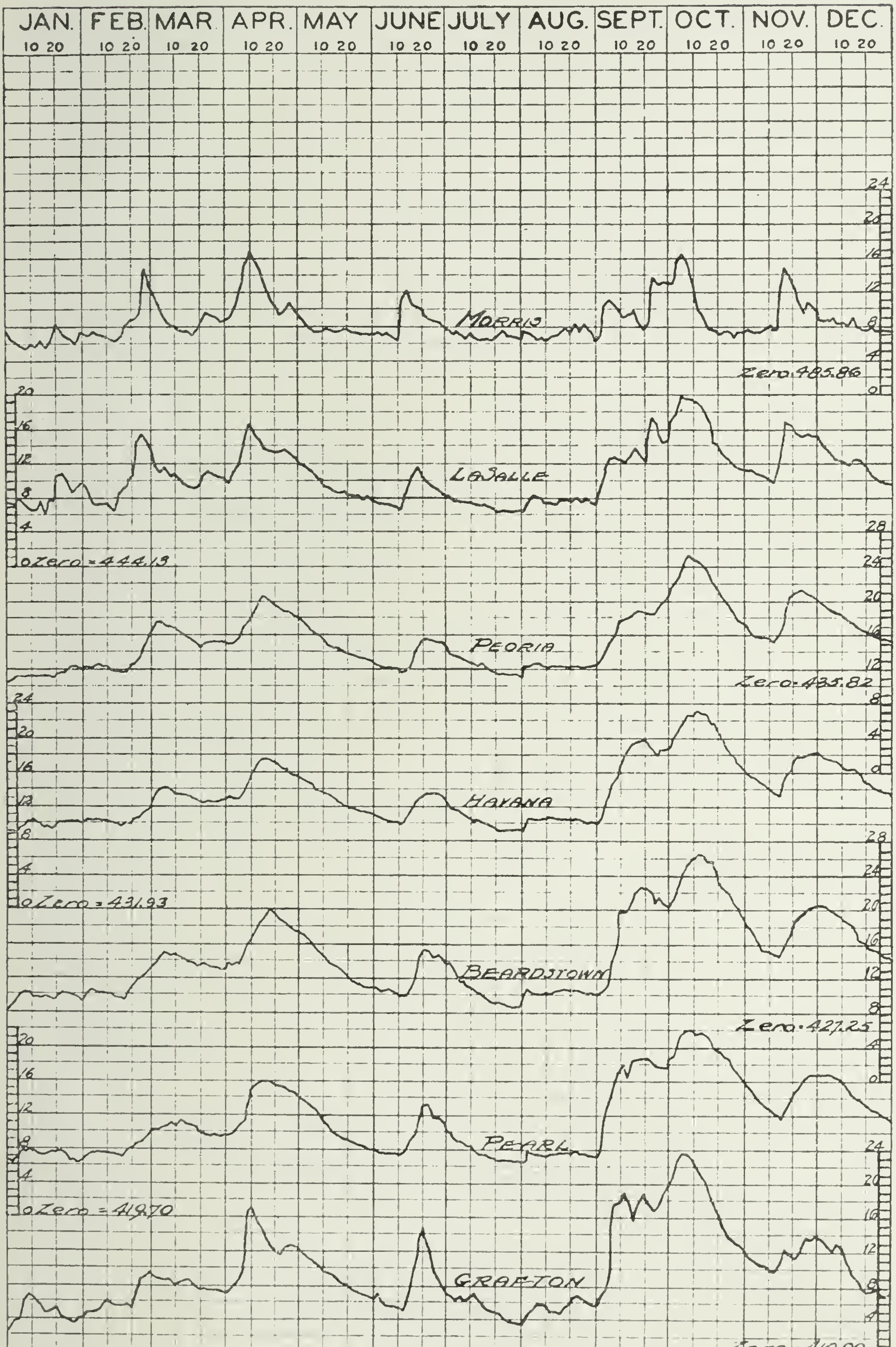
HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1925
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
BY JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B 46

HYDROGRAPH OF DAILY RIVER STAGES
ILLINOIS RIVER 1926
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By JACOB A. HARMAN, Consulting Engineer



REPORT OF 1928

FIGURE B 47

HYDROGRAPH OF DAILY RIVER STAGES
Illinois River 1927
REPORT ON FLOOD CONTROL OF THE ILLINOIS RIVER
DIVISION OF WATERWAYS, STATE OF ILLINOIS
By Jacob A. Harman, Consulting Engineer

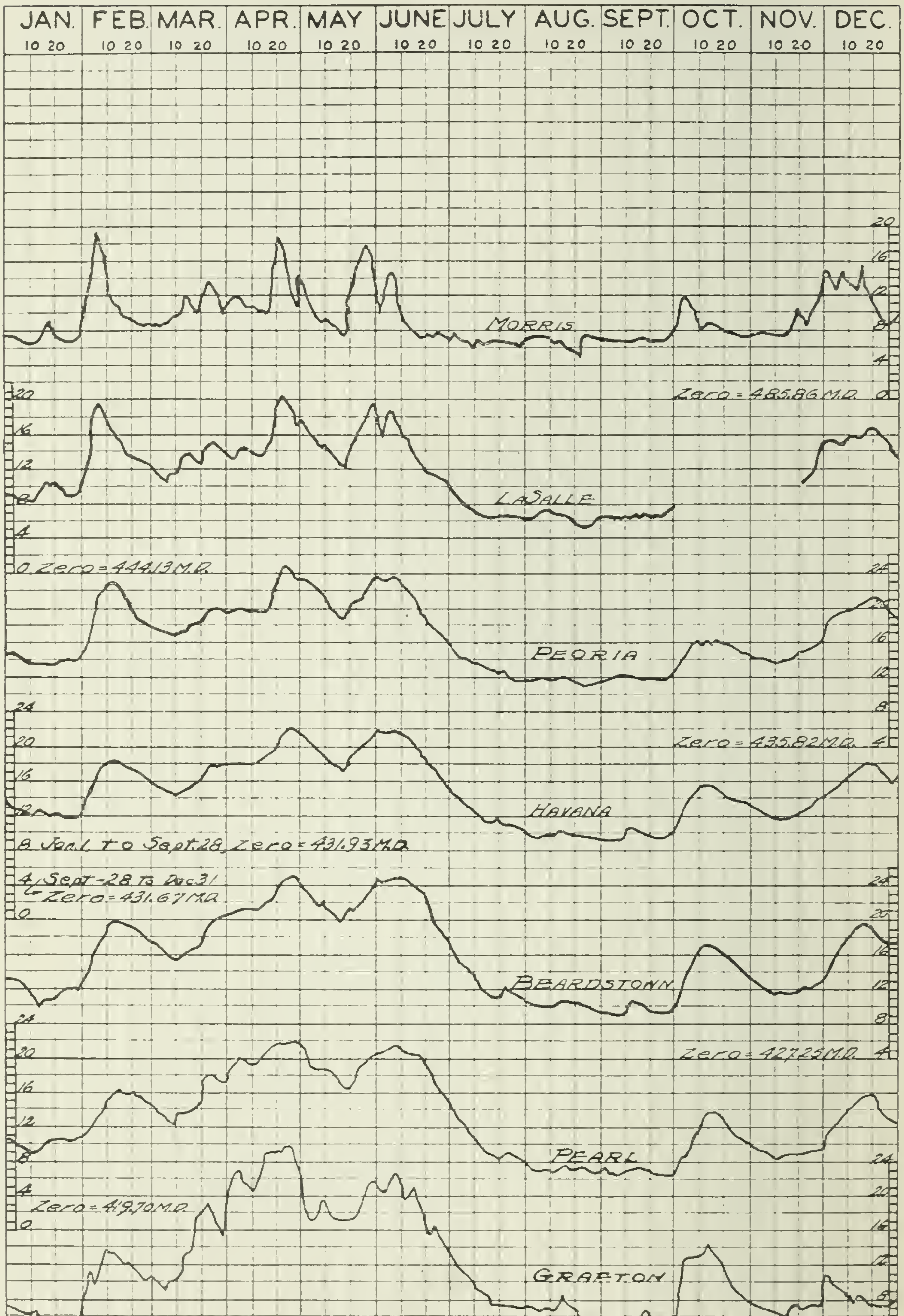


FIGURE B 48